AR-008-910

DSTO-TR-0049

Enhancement of F/A-18 Operational Flight Measurements

Data Report for Phase 1

B.A. Woodyatt
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S.D. Hill

DEPARTMENT OF DEFENCE
DEFENCE SCIENCE AND TECHNOLOGY ORGANISATION

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Aeronautical and Maritime Research Laboratory

ABSTRACT

Technical Report

This report describes the procedures used in the processing of approximately 300 hours of flight maintenance data from the F/A-18's Maintenance Status Display and Recording System (MSDRS). A Flight Path Reconstruction (FPR) program and a modified F/A-18 mathematical model from the US Naval Air Warfare Center Aircraft Division (NAWC-AD) were used to enhance these flight data in resolution and frequency. DSTO's Airframes and Engines Division (AED) will use these enhanced flight data to obtain a representative flight load spectrum. The load spectrum will be used in a full scale fatigue test of the empennage and aft fuselage of an F/A-18, the Australian contribution to the International Follow-On Structural Test Programme (IFOSTP). IFOSTP is a joint collaboration between the Canadian Forces (CF) and the Royal Australian Air Force (RAAF) to appraise structural modifications to the F/A-18 designed to achieve a service life of 6000 hours.

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DSTO-TR-0049

DEPARTMENT OF DEFENCE

DEFENCE SCIENCE AND TECHNOLOGY ORGANISATION

Published by

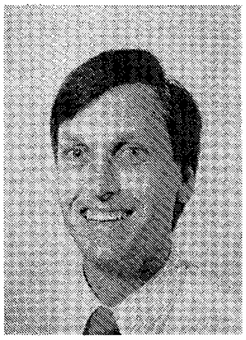
DSTO Aeronautical and Maritime Research Laboratory
GPO Box 4331
Melbourne Victoria 3001 Australia

Telephone: (03) 626 7000
Fax: (03) 626 7999

AR No. 008-910
AUGUST 1994

APPROVED FOR PUBLIC RELEASE

Authors



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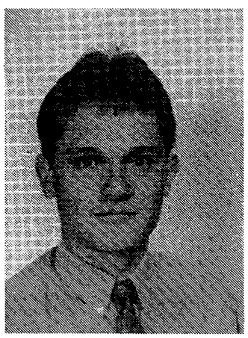

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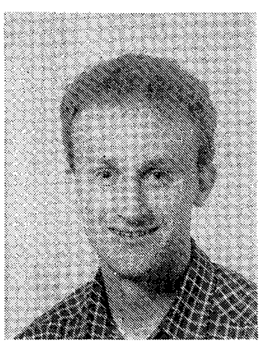

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EXECUTIVE SUMMARY

This report describes the procedures used in the processing of approximately 300 hours of flight maintenance data from the F/A-18's Maintenance Status Display and Recording System (MSDRS). These data will be used in the International Follow-On Structural Test Programme (IFOSTP). IFOSTP is a collaboration between the Canadian Forces (CF) and the Royal Australian Air Force (RAAF) to evaluate structural modifications to the F/A-18 with the aim of achieving a service life of 6000 hours. DSTO's Airframes and Engines Division (AED) has been tasked under IFOSTP to conduct a full scale fatigue test of the empennage and aft fuselage of an F/A-18. To develop a suitable loading spectrum for IFOSTP, AED required a more comprehensive set of flight data than was provided by the MSDRS. Staff from the Air Operations Division (AOD) used a six degree of freedom flight dynamic model of the F/A-18 to enhance the MSDRS data in resolution and frequency as required. In addition, the enhancement of these data enabled the estimation of other relevant parameters, for example side slip angle, which are not normally measured or recorded by the MSDRS. The MSDRS data were used with the enhancement procedures described in this report to provide "sanitised" data to derive a load spectrum for IFOSTP.

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NOTATION

Acronyms

AED	Airframes and Engines Division
AOD	Air Operations Division
CF	Canadian Forces
CPU	Central Processing Unit
DSTO	Defence Science and Technology Organisation
FPR	Flight Path Reconstruction
IFOSTP	International Follow-On Structural Test Programme
LEX	Leading Edge Extension
MAG	Magnetic Tape
MSDRS	Maintenance Status Display and Recording System
NAWC-AD	Naval Air Warfare Center Aircraft Division
PID	Proportional Integral and Derivative
RAAF	Royal Australian Air Force

Symbols

N_{Thr}	Number of points within a particular threshold
N_{Tot}	Total number of points in the sample
ε_{Thr}	Sum of the reconstruction error for all points for each measurand
ε_{Tot}	Sum of the errors for all points for a particular measurand

1 Introduction

The International Follow-On Structural Test Programme (IFOSTP) is a collaboration between the Canadian Forces (CF) and the Royal Australian Air Force (RAAF) to evaluate structural modifications to the F/A-18 with the aim of achieving a service life of 6000 hours [1]. DSTO's Airframes and Engines Division (AED) has been tasked under IFOSTP to conduct a full scale fatigue test of the empennage and aft fuselage of an F/A-18. The Canadians will test the centre fuselage and wing sections. The test specimens are representative of F/A-18 models A and B currently in service with both the CF and RAAF.

The load spectrum for Phase 1 of the Australian fatigue test will be derived from approximately 300 hours of measured flight data. These data were recorded by the F/A-18's Maintenance Status Display and Recording System (MSDRS). To develop a suitable loading spectrum for IFOSTP, AED required a more comprehensive set of flight data than was provided by the MSDRS. The resolution and frequency of some MSDRS parameters were not considered adequate for developing this spectrum and staff from the Air Operations Division (AOD) used a six degree of freedom flight dynamic model of the F/A-18 to enhance the MSDRS data in resolution and frequency as required. In addition, the enhancement of these data enabled the estimation of other relevant parameters, for example side slip angle, which are not normally measured or recorded by the MSDRS.

The Phase 1, or SPEC5, data were taken from an RAAF F/A-18, tail number A21-107, for the period May 1985 to October 1988 and are considered to be representative of RAAF fleet usage for this period [1]. The test specimen will be subjected to structural loads which include both a manoeuvre and buffet load component for high angles of attack. Operating the F/A-18 at angles of attack in excess of 10° produces a buffet loading on the aft fuselage [1]. The buffet loading is caused by bursting of the vortices from the aircraft's Leading Edge Extensions (LEX) and this has, in the past, resulted in the premature failure of fin attachment stubs on the aft fuselage frames [1].

Since December 1988, all RAAF F/A-18s have been fitted with fences on the LEX to alleviate the effects of tail buffet. Phase 2, or SPEC16, data cover this later period of operation.

The techniques used to process and enhance the SPEC5 data for IFOSTP are presented in this report. The issues of accuracy and reliability of the MSDRS data are not addressed in this report.

2 The Maintenance Status Display and Recording System

The MSDRS stores data on magnetic tape using a numerical code system. Flight incident data, relating to aircraft systems, the deflection of control surfaces and aircraft attitude are stored in formats known as either code 45 or 46. These two codes differ slightly in content and resolution, with code 46 having superseded code 45 [1]. Flight incident data are recorded continuously throughout each flight at either 0.2 Hz or 1 Hz. In contrast, the fatigue codes 51 - 62 refer to

specific areas of the airframe, and are only triggered by the MSDRS when the loads on that part of the airframe exceed some threshold. Two reference timers are used by the MSDRS to record the time of events. `FTime`, or flight time, is a continuous reference time with a 1 second resolution which cycles between zero and 65535 seconds. The other reference time, `PDtime`, is the time at which an event is recorded by the MSDRS. `PDtime` has a 50 millisecond resolution and is reset each time the aircraft's Mission Computer power is recycled [1]. Flight incident codes record both reference times whereas fatigue codes record only `PDtime`.

3 The Processing and Enhancement of the SPEC5 Data

The procedure developed to process and enhance the SPEC5 data involved many steps. To ensure each of the steps was properly implemented, the progress of each flight through the procedure was recorded on an F/A-18 MSDRS Data Enhancement Log. Information such as the flight number, type of flying, the duration of the flight, the processed flight time and any processing problems were recorded on the log sheet. Appendix A contains a typical log sheet for a SPEC5 flight.

The steps followed to process and enhance these data are now discussed.

3.1 Extraction of the MSDRS Parameter Data

The first step in the procedure was the extraction of each complete flight history from the MSDRS data. The SPEC5 MSDRS data were provided to AOD in a binary MAG file format [2]. These data were read using program FILTER, a modified version of program EXTRACT developed by staff from AED [3]. FILTER allowed the user to retrieve MSDRS data for a particular flight in parameter groups, for example engine data, fatigue data and one second data and/or as separate flight parameters such as altitude or velocity. FILTER read an input file titled FLIGHTS which contained a flight number and the time range to be processed. The flight number uniquely identified each flight, and the start and end times identified the time segment of the record being read. An example of a FLIGHTS file is:

```
a86001252.mag 0 99999,
```

where `a86001252.mag` is the flight number and `0` and `99999` define the processing range. The processing times `0` and `99999` were used initially to extract the entire time history for each flight.

FILTER produced the following prompts when run:

```
Create FPR data files (Y/N) ?
Create F18 NAWC-AD input data file (Y/N) ?
Create One Second data file (Y/N) ?
```

```
Create Fatigue data file (Y/N) ?
Create Engine data file (Y/N) ?
Create separate data files (Y/N) ?
Output separate data using FT or PD time ?
Zero start times (Y/N) ?
Remove time jumps if found (Y/N) ?
Code number to use (85 or 87) ?
```

Initially, a response of "no" to all of the `(Y/N)` prompts, with the exception of:

```
Create separate data files (Y/N) ?
```

was entered. The reference time used in these separate data files was nominated at the prompt:

```
Output separate data files using FT or PD time ?
```

This option was only available to the user when separate data files were requested. The SPEC5 flights were processed using `FTime` as the reference time.

The final prompt:

```
Code number to use (85 or 87) ?
```

referred to the data format being read. The integers 85 and 87 corresponded to the version of the Mission Computer software on which the MSDRS were recorded. SPEC5 data were code 45, and were recorded using the 85A Mission Computer software, whereas code 46 data were recorded using the more recent 87X Mission Computer software.

These responses produced a group of single parameter data files as a function of `FTime`. Plotting some of these data enabled time jumps and repeated data blocks to be located, processing times to be refined and any anomalies in the data to be easily identified. All of the data files created by FILTER had the last four digits of the flight number as a suffix, for example az.1252.

3.1.1 Time Jumps and Repeated Data

`FTime` and `PDtime` data were output to the flight times file flt_times.1252 by default when FILTER was run. This file was used to detect time jumps and repeated data blocks. A time jump describes the period during a flight where a code event was not recorded or was incomplete. Time jumps occurred in the majority of the SPEC5 flights and varied in their length and frequency. Time jumps were caused by system malfunctions. Because of the procedures used to transfer data from the MSDRS tapes to the individual flight files, some files contained data from the end of the previous flight and/or the start of the next flight. These data were separated by a time jump. To process the SPEC5

flights, `FTime` had to be sequential and continuous (ie no time jumps). In most instances, time jumps were avoided by nominating the appropriate start and the finish times in FLIGHTS file. The option in FILTER:

```
Remove time jumps if found (Y/N) ?
```

was only able to remove time jumps which were a multiple of five seconds. Small time jumps within a flight were removed using this FILTER option. Figure 1 shows an example of a flight with a time jump.

Repeated data blocks were not as common as time jumps in the SPEC5 data. However, repeated data blocks also had to be avoided during processing. A repeated data block described the recording of different events in the history of a flight against the same reference time. As with time jumps, repeated data blocks were avoided by nominating the appropriate start and finish times in the FLIGHTS file.

3.2 Refining the Processing Times

Two of the separate data files created by FILTER were altitude (eg alt.1252) and velocity (eg vek.1252). To enhance the MSDRS data, a plot of altitude and velocity had to show the aircraft to be in flight. The two conditions used to constitute flight were an altitude $\geq$ 512 ft and a velocity $\geq$ 180 kts. Plotting these data was the simplest way to confirm the aircraft was flying. There were many examples in the SPEC5 data where one of these flight conditions was not satisfied. The times during a flight where both conditions were not met, for example during a touch and go manoeuvre, were recorded on the log sheet and avoided during processing.

The software used to enhance the MSDRS data required the processing range for each flight to be a multiple of five seconds, that is the difference between the start and end times had to be divisible by five. It was therefore convenient to use data files with a frequency of 0.2 Hz, for example alt.1252, to select the processing times. The start and end times were amended in the FLIGHTS file to avoid time jumps, repeated data blocks and any other problems and FILTER was re-run. A "yes" response was given to all `(Y/N)` choices listed in the previous section. A summary of the files created by FILTER is given in Table 1.

The next step in the procedure was the enhancement of the SPEC5 data. The enhancement of the data was performed in two parts. The first part involved passing selected MSDRS parameters through the Flight Path Reconstruction (FPR) program. In the second part, the output data from FPR together with the MSDRS data were used as input into a flight dynamic model of the F/A-18. Both parts of the enhancement process are discussed below.

3.3 Flight Path Reconstruction

The aircraft attitude data (ie roll angle (ϕ), pitch angle (θ) and yaw angle (ψ)) were recorded by the MSDRS at a lower frequency (ie 0.2 Hz) than the aircraft angular rate data (ie roll rate (p), pitch rate (q) and yaw rate (r)). In the first step of the enhancement process, FPR was used to reconstruct the aircraft attitude data using the angular rates. FPR was able to produce attitude data at the higher frequency of 4 Hz as required by the flight dynamic model.

A brief description of how FPR was used to reconstruct the SPEC5 data is included below, and the methodology of FPR is covered in detail in Reference [2].

3.3.1 Running FPR

The MSDRS data needed to run FPR were extracted by FILTER with a "yes" response to:

```
Create FPR data files (Y/N) ?
```

The two data files produced by FILTER with this response were a file which included aircraft angular rate data (eg 1252.ab), and a file which included aircraft attitude data (eg 1252.c).

To run FPR, responses to the following prompts were needed:

```
Enter input (p,q,r) file ::                    1252.ab
Enter input (psi, theta, phi) file ::          1252.c
Enter output file / Flight No.  ::             1252
Enter integration time step ( / for def) :: 0.05
Enter frame limit ( / for all) ::              5
Enter Sigma ::                                 1.0
Calculate Vt from altitude (Y/N) ::            N
Limit VIAS to 50 knots (Y/N) ::                N
Predictor / Corrector ON (Y/N) ::              Y
Use Euler Predictor (Y/N) ::                   Y
Enter Heading / Weight Ratio ::                0.1
Enter Bias Limit (deg) ::                      5.0
Zero Heading ON (Y/N) ::                       Y
Create NAWC-AD input files only (Y/N) ::       Y
Enter p,q,r (deg/sec) & Ay (g) offsets ::      2,2,2,0.0625
```

The responses shown alongside each prompt were typical of those used to process the SPEC5 data, and a brief explanation of some of these is presented here.

The names of the input files used by FPR were nominated using the prompts:

```
Enter input (p,q,r) file
Enter input (psi,theta,psi) file.
```

The suffix appended to the end of each output file produced by FPR was entered using the prompt:

```
Enter output file / Flight No.
```

The last four digits of each flight number was used during the enhancement of the SPEC5 data, for example 1252.

FPR uses an integration routine and the equations of motion to calculate higher resolution aircraft attitude data from the aircraft angular rates. The time step used in the integration was set using the prompt:

```
Enter integration time step (/ for def).
```

The frequency of the aircraft attitude data output by FPR was set using the prompt:

```
Enter frame limit (/ for all).
```

The frame limit multiplied by the integration time step defined the frequency of the output data. The SPEC5 data were processed using a frame limit of 5 /s and an integration time step of 0.05 s producing output at a frequency of 4 Hz.

The MSDRS angular rate data were curve fitted by FPR using a tension spline fit. The tension of the spline fit was determined through experience and was not changed during the enhancement of the SPEC5 data. The tension was set at the prompt:

```
Enter Sigma.
```

Integration errors can cause significant discrepancies between measured and predicted results. To overcome this problem, an integration corrector was incorporated into FPR. The prompt:

```
Predictor / Corrector ON (Y/N)
```

enabled the user to turn the integration corrector routine OFF and ON.

The prompt:

```
Enter Heading / Weight Ratio
```

allowed the user to control the weighting on aircraft heading angle used in the integration corrector. The corrector performs a weighting of the measured to the predicted heading angle, where the ratio relates to the reliability of the measured value. The value of the heading / weight ratio was determined through experience and was not changed during the enhancement of the SPEC5 data.

When the user engaged the integration corrector, the measured and predicted data were compared at five second intervals and an influence matrix of aircraft attitude and angular rate data was produced. From these results a set of biases for the angular rates was calculated. The integration was repeated using angular rate data incremented by the biases. The aim was to minimise the drift between the measured and predicted results. The maximum bias applied to any of the angular rates was nominated by the user at the prompt:

```
Enter the Bias Limit.
```

Calculated biases in excess of this limit were truncated to the maximum value.

The prompt:

```
Zero Heading ON (Y/N)
```

allowed the user to set the heading at the first time point to north, irrespective of the actual heading. All subsequent headings in the file were adjusted accordingly.

The prompt:

```
Create NAWC-AD input files only (Y/N)
```

enabled the user to produce only those files required for input into the F/A-18 dynamic model (ie the second part of the enhancement process).

The resolution at which some MSDRS data were recorded was low for present purposes. Recorded data were truncated to the nearest resolution by the MSDRS rather than rounded. Where the resolution in a particular channel was high, the difference between the measured value and the recorded result was often significant (eg SPEC5 angular rate data were recorded at a resolution of 4 °/s whereas lateral acceleration was recorded at a resolution of 0.125 G). To compensate for the truncation of these data by the MSDRS, FPR allowed the user to nominate offsets to be added to the p, q, r and lateral acceleration data. These increments were specified at the prompt:

```
Enter p,q,r (deg/s) & Ay (G) offsets.
```

The higher frequency and resolution attitude data produced by FPR were output to separate data files (eg phi.fb1252, theta.fb1252 and psi.fb1252). For

each flight, the results from FPR were graphically compared with the original MSDRS data (ie phi.1252, theta.1252 and psi.1252) and any noteworthy differences between the measured and predicted results were recorded on the log sheet. The reconstructed data from FPR were used as inputs into the F/A-18 flight dynamic model.

3.4 Using the Naval Air Warfare Center F/A-18 Flight Dynamic Model for the Enhancement of SPEC5 Data

A six degree of freedom flight dynamic model of the F/A-18 was provided to DSTO by the United States Naval Air Warfare Center Aircraft Division (NAWC-AD), Patuxent River, Maryland. The NAWC-AD model has the aerodynamic and control system response characteristics of an operational F/A-18. MSDRS data such as longitudinal and lateral stick deflections and rudder pedal forces were used as inputs into the model to reconstruct each SPEC5 flight profile. Deviations by the model from the desired trajectory were minimised by a Response Following Controller (RFC). Developed by staff from AOD, the RFC was a Proportional Integral and Derivative (PID) system which used a set of fixed gain Kalman filters for drift correction. Reference [2] describes the RFC in more detail.

The NAWC-AD model was installed on a DEC MicroVAX/VMS system. A feature of the VAX/VMS was DEBUG, an interactive VAX program which allowed the user to manipulate variables during the execution of a program. The NAWC-AD model makes use of and was run in DEBUG. A configuration file was used to setup aircraft parameters including mass, inertia, fuel load and stores. Appendix B shows an example of this setup file.

The CPU time consumed during each run meant flight cases were rarely run on-line but instead submitted as batch jobs. The model required inputs to the following prompts for both on-line or batch mode running:

```
Option Number (0,1,2,3) ?
     0 - No control system
     1 - Feedback control ONLY
     2 - Direct (MSDRS) ONLY
     3 - Using feedback control & direct (MSDRS) input
Do you want to create data files (Y/N) ?
Create FPR format file (Y/N) ?
Create F18 Loads extended files (Y/N) ?
Time Shifting (Y/N) ?
```

The level of implementation of the RFC was controlled by the prompt:

```
Option Number (0,1,2,3) ?.
```

For example all of the the SPEC5 data were enhanced using feedback control and direct MSDRS input (eg option 3). Output files were produced with a "yes" response to the prompt:

```
Do you want to create data files (Y/N) ?.
```

The file options:

```
Create FPR format file (Y/N) ? and
Create F18 Loads extended files (Y/N) ?
```

were only presented to the user when a "yes" response was given at the previous prompt. During the processing of the SPEC5 data, a "yes" response was only given to the file option:

```
Create F18 Loads extended files (Y/N) ?.
```

A "yes" response to the prompt:

```
Time shifting (Y/N) ?
```

was entered for the processing of all SPEC5 data to eliminate time synchronisation errors arising from integration methods used in the model. The responses to these prompts along with the model operating commands were entered into a run-file when the model run was submitted as a batch job. Appendix C shows an example of a run-file. Two data files were produced by the model using these responses. These files contained fatigue data (eg f18loads1.1252) and reconstructed incident data (eg f18load2.1252). The last four digits of each flight number were appended to the model output files. Table 2 shows a list of the flight incident parameters produced by the model.

3.5 Assessing the Accuracy of the Enhanced Data

For each of the SPEC5 flights, the enhanced data produced by the NAWC-AD flight dynamic model were compared with the measured MSDRS data to ensure the enhancement was of an acceptable standard. The two methods used to access the acceptability of the results were a statistical analysis of a select group of parameters and a graphical comparison of some of these parameters.

The statistical analysis required programs RFCS85 and RFCF85 to be run for each SPEC5 flight. RFCS85 compared the measured data with the predicted results at times of peak activity during a flight, whereas RFCF85 compared the measured data with the predicted results throughout the entire flight. Each program produced a statistical summary sheet, and the format of the summary sheet was the same for both programs. The resolution at which MSDRS flight incident data were recorded varied between channels, and the accuracy of the NAWC-AD results were measured as a function of each measurand's resolution (eg the MSDRS recorded angle of attack at a resolution of 1.4°). The differences between the measured MSDRS data and the predicted results were tabulated in the summary sheet as a function of the number of resolution intervals for

each of the selected measurands. For each of the measured data points, the predicted value was categorised as being somewhere within 1 to 20 resolutions of the measured value. Predicted values in excess of 20 resolutions of the measured value were counted as being at 20 resolutions.

To determine whether an enhanced flight was accepted or rejected, 50% and 90% acceptability and confidence values for each of the selected MSDRS measurands were included in the summary. The acceptability criterion was calculated using a threshold value, where the number of predicted values within the particular threshold (N_{Thr}) were expressed as a ratio of the total number of points in the sample (N_{Tot}):

$$Acceptability = \frac{N_{Thr}}{N_{Tot}}. \tag{1}$$

The 50% and 90% threshold values for each measurand were nominated by AED and are listed in Table 3. An enhanced flight was considered acceptable only if the 50% acceptability results were above 0.5, and the 90% acceptability results were above 0.9 for all of the selected measurands. In addition, confidence levels were defined by weighting the importance of the departures of unacceptable points in the reconstruction. The confidence level was determined by summing the reconstruction error of all points for each measurand (ε_{Thr}) where the error was within the specified threshold, and expressing the result as a ratio of the sum of the errors for all points for that measurand (ε_{Tot}):

$$Confidence = \frac{\sum \varepsilon_{Thr}}{\sum \varepsilon_{Tot}}. \tag{2}$$

The confidence levels were indicators of the relative importance of badly reconstructed points and were used to determine whether further investigation into the reconstruction problem was warranted for a flight for which the acceptability results were questionable. High confidence values were desirable.

Figure 2 shows a typical summary sheet produced by RFCF85. A summary of the partial and complete statistical data for the SPEC5 flights is given in Appendix D.

Only a subset of the channels analysed by RFCS85 and RFCF85 were plotted. The channels plotted were:

- Angle of Attack (α),
- Normal Acceleration (N_z),
- Roll Rate (p) and
- Pitch Rate (q).

Any marked differences between the measured and enhanced data were noted on the log sheets. Only those flights deemed to be acceptable reconstructions of the MSDRS data were processed further. The results from any unacceptable reconstructions were analysed in detail and if possible, a corrective measure such as those discussed in the next section was implemented to achieve an acceptable enhancement.

3.6 Binary Data Files

The enhanced flight data were converted to a binary format for AED. The binary versions of the flight data included both enhanced and measured MSDRS data. Although the NAWC-AD model faithfully reproduced many of the parameters required for IFOSTP, some of the original MSDRS data were preferred to the reconstructed results, for example engine data. The engine model had not been tested against the real data and therefore raw MSDRS data were preferred. To create the binary data, program F182BIN was run with these files present:

f18loads1.1252	the NAWC-AD fatigue data file,
f18loads2.1252	the NAWC-AD flight incident data file,
1sec.1252	a select group of MSDRS data at 1 Hz,
fat.1252	containing MSDRS fatigue data and
eng.1252	containing MSDRS engine data,

where the flight number 1252 is shown here only as an example.

The flight number and processing times for each flight were read from the FLIGHTS file when F182BIN was run. F182BIN created two binary files, the name of each file prefixed by a flight number (eg a86001252.eflt containing flight incident data and a86001252.efat containing fatigue data).

4 The Storage of Software and Results from the Enhancement of the SPEC5 Data

A copy of the software used in the enhancement of the SPEC5 flight data along with copies of the enhanced data and the statistical summary sheets are archived in the AOD software archives. The software and data are stored on an 8 mm data tape in TAR (Tape ARchive) format. A complete listing of the tape's contents is provided in Tables 4, 5 and 6.

5 Results

Of the 290 SPEC5 flights enhanced (ie approximately 300 hours of data), 288 were deemed acceptable and 2 flights were rejected. The rejected flight cases produced enhanced results which did not meet the standards specified by AED and therefore were not used for IFOSTP. Table 7 includes a listing of all of the SPEC5 flights successfully enhanced for AED along with details of the location and duration of any time jumps within the data.

Following a preliminary inspection of the enhanced SPEC5 data, AED requested an extension of the processing range for several of the flights. A summary of the complete statistical data sheets covering the extended processing ranges for these flights has been included in Appendix E. Table 7 was amended to include the extended processing ranges.

During enhancement of the SPEC5 data several problems kept recurring which required special attention. The most common problems are discussed here along with the methods used to overcome them.

5.1 Spikes in the MSDRS Data

The recording of spurious data by the MSDRS occurred through equipment malfunction. The significance of these spurious data was dependent on the period over which the data were recorded and the channels affected. The presence of a single uncharacteristic peak value, or spike, in a data channel was the most common occurrence. With the exception of the roll rate channel, spikes did not affect the enhancement and therefore were not removed or modified prior to running the flight dynamic model. However, failure to remove or modify a peak value in the roll rate channel caused the model to attempt to simulate the peak value producing a poor reconstruction. Spikes in the roll rate data were either avoided or replaced with more realistic values calculated from neighbouring points. Figure 3 shows an example of a data spike in an MSDRS record.

5.2 Flap Deflections in Flight

The operation of flaps during normal flight is a function performed by the control system and the pilot is only able to manually select two flap settings, namely half and full flap. The scheduling of half or full flap is normally reserved for take-off and landing. The selection of flaps manually during flight prompts the controller to attempt to match the desired flap setting if the flight condition is suitable (ie safe to extend the flaps). Some flight histories contained pilot initiated flap deflections during flight. The NAWC-AD model was unable to accurately reconstruct the selection of either half or full flaps. In the majority of cases, the times during which flaps were deflected were noted on the log sheet and no further action was taken. For the flights where the flaps were deflected for a prolonged period or the reconstruction was particularly poor, the flight case was re-run and the processing times adjusted to exclude the period of flap deflection. Figure 4 shows an example of flap deflections during flight.

5.3 Touch and Go Manoeuvres

A small proportion of the flights processed contained a Touch and Go manoeuvre. In a Touch and Go manoeuvre, the pilot configures the aircraft for landing but during the landing roll the pilot transitions the aircraft to a take off roll and the aircraft takes off. Because of the deflection of flaps during landing, the NAWC-AD model was unable to reconstruct this flight manoeuvre. Altitude and velocity traces were used to identify Touch and Go manoeuvres during a flight. Flights containing a Touch and Go were processed in parts, and the segment of a flight containing a Touch and Go was not processed. When a flight included several Touch and Go manoeuvres, the flight time between manoeuvres had

to exceed 500 seconds to justify enhancement; otherwise, it was not processed. Figure 5 shows an example of a Touch and Go during a flight.

5.4 External Fuel Tanks

The NAWC-AD model was unable to accommodate the scheduling of fuel from external fuel tanks. The fuel quantity passed to the model had to be the internal capacity only, that is a maximum of 10860 lb (4936 kg). The fuel quantity recorded by the MSDRS represents a total amount, or the sum of internal and external fuel and therefore could not exceed 10860 lb (4936 kg) when external tanks were fitted. On the occasions where external tanks were fitted and the total fuel load exceeded 10860 lb (4936 kg), unacceptable control surface deflection reconstructions were produced by the model resulting from the shift in the aircraft's centre of mass. As the total fuel quantity dropped below 10860 lb (4936 kg) (eg all the external fuel was burnt) the control surface deflection reconstructions improved. Limiting the maximum fuel mass to 10860 lb (4936 kg) neglected the mass of the fuel in the external tanks, although the mass of the empty external tanks themselves was modelled in the setup file (refer Appendix B). No corrective action was taken to accommodate an excess fuel load. As the fuel load was reduced during a flight, the quality of the enhancement improved. Figure 6 shows the effects of a total fuel load in excess of 10860 lb (4936 kg).

5.5 High Angle of Attack

A significant proportion of SPEC5 data contained periods of flight where the angle of attack exceeded 20°. In these cases, a comparison of MSDRS and model results often showed unacceptable deviations between the measured and predicted data, in particular control surface deflections (eg stabilator and rudder). To compensate for high angle of attack flight, a drift correction technique was included into the RFC. The technique involves a comparison of the measured and calculated aircraft control surface deflections by applying a fixed gain Kalman filter. Reference [2] gives a detailed description of this technique. To activate the drift corrector a switch was inserted into the aircraft setup file (refer Appendix B) which was set when a flight was designated a high angle of attack flight.

Figure 7 shows the stabilator deflection for a reconstruction with and without the drift correction over a portion of a flight where the angle of attack exceeds 20°.

5.6 Normal Acceleration

The enhancement of a small number of the SPEC5 flights showed the reconstruction of normal acceleration data was poor. The predicted data were offset from the the measured results by a small margin, typically 0.1 to 0.5 G. To overcome this discrepancy, the RFC was modified to include a feedback loop on normal acceleration. Feedback on normal acceleration was controlled through

longitudinal stick input. The difference between measured and calculated normal acceleration was used to incrementally adjust the longitudinal input using a PID controller. This pitched the aircraft by a small angle to attain the correct G loading. The feedback loop was implemented through a switch in the aircraft setup file when a flight was designated as having offsets in the normal acceleration data. Figure 8 shows a comparison between the MSDRS data and the enhanced results with the normal acceleration feedback OFF and ON.

6 Conclusion

The procedures used to enhance the MSDRS SPEC5 flight data together with a summary of the results are included in this report. The MSDRS data can be used with the enhancement procedures to provide "sanitised" data to derive a load spectrum.

REFERENCES

[1] Higgs, M.G.J., RAAF F/A-18 Usage spectrum development (pre-LEX fence period of flying), DSTO Aeronautical Research Laboratory, Aircraft Structures Technical Memorandum 548, Melbourne, October 1991.

[2] Hill, S.D., Enhancement of the F/A-18 flight data for the IFOSTP using the Response Following Controller, DSTO Technical Report (DRAFT), DSTO Air Operations Division, Melbourne, 1994.

[3] White, P., EXTRACT program description, DSTO Technical Report (DRAFT), DSTO Airframes and Engines Division, Melbourne, 1993.

Table 1: A summary of files produced by FILTER

NAWC-AD Files	FPR Files	Separate Data Files	Parameter
		aill.****	Left aileron
		ailr.****	Right aileron
		ruddl.****	Left rudder
		ruddr.****	Right rudder
		stabl.****	Left stabilator
		stabr.****	Right stabilator
		tefl.****	Left trailing edge flap
		tefr.****	Right trailing edge flap
		lonstk.****	Longitudinal stick
		stklat.****	Lateral stick
da.fb****			Aileron deflection
de.fb****			Elevator deflection
dr.fb****		dr.****	Rudder pedal force
pl.fb****		pl.****	Power lever angle
		alpha.****	Angle of attack
		phi.****	Roll angle
		theta.****	Pitch angle
		psi.****	Yaw angle
		p.****	Roll rate
		q.****	Pitch rate
		r.****	Yaw rate
alt.fb****		alt.****	Altitude
		ay.****	Lateral acceleration
		az.****	Normal acceleration
vek.fb****		vek.****	Flight velocity
trim.fb****			Trim conditions
fuelt.fb****		fuelt.****	Total fuel
		iblel.****	Left inboard L.E. flap
		ibler.****	Right inboard L.E. flap
fat_rr.fb****			Fatigue roll rate data
	****.ab		One second MSDRS data
	****.c		Five second MSDRS data

Other data format options produced by FILTER include;

- flt_times.**** file which is produced by default,
- 1sec.**** containing a selection of 1Hz MSDRS flight incident data,
- fat.**** containing MSDRS fatigue data and
- eng.**** containing MSDRS engine data,

where **** is used to represent the last four digits of a flight number.

Table 2: Flight incident data produced by the NAWC-AD model.

Channel	Parameter	Units
1	Flight time	s
2	Dynamic pressure	lbf/ft^2 (Pa)
3	Mach number	-
4	Altitude	ft (m)
5	Normal acceleration	G
6	Angle of attack (α)	deg
7	Roll rate (p)	deg/s
8	Roll acceleration ($\dot{p}$)	deg/s^2
9	Left horizontal tail deflection angle	deg
10	Right horizontal tail deflection angle	deg
11	Left rudder deflection angle	deg
12	Right rudder deflection angle	deg
13	Side slip angle (β)	deg
14	Left trailing edge flap deflection angle	deg
15	Right trailing edge flap deflection angle	deg
16	Left leading edge flap position	deg
17	Right leading edge flap position	deg
18	Pitch angle (θ)	deg
19	Left aileron deflection angle	deg
20	Right aileron deflection angle	deg
21	Roll angle (ϕ)	deg
22	Pitch rate (q)	deg/s
23	Yaw rate (r)	deg/s
24	Pitch acceleration ($\dot{q}$)	deg/s^2
25	Yaw acceleration ($\dot{r}$)	deg/s^2
26	Lateral acceleration	G
27	Left rudder hinge moment	lbf in (Nm)
28	Right rudder hinge moment	lbf in (Nm)
29	Left horizontal tail hinge moment	lbf in (Nm)
30	Right horizontal tail hinge moment	lbf in (Nm)

Table 3: The 50% and 90% threshold values for the MSDRS measurands.

Measurand	MSDRS Resolution	Threshold 50%	Threshold 90%	Units
Angle of attack	1.4	2.8	5.6	deg
Normal acceleration	0.125	0.25	0.5	G
Roll rate (p)	4.0	4.0	8.0	deg/s
Pitch rate (q)	4.0	4.0	8.0	deg/s
Left stabilator	0.35	1.05	2.1	deg
Right stabilator	0.35	1.05	2.1	deg
Left trailing edge flap	0.35	1.05	2.1	deg
Right trailing edge flap	0.35	1.05	2.1	deg
Left inboard leading edge flap	0.35	1.05	2.1	deg
Right inboard leading edge flap	0.35	1.05	2.1	deg
Left rudder	0.35	2.1	4.2	deg
Right rudder	0.35	2.1	4.2	deg

Table 4: Archived SPEC5 flight incident & fatigue records

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Table 4 (cont.): Archived SPEC5 flight incident & fatigue records

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Table 4 (cont.): Archived SPEC5 flight incident & fatigue records

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/f18/flights/raaf/enhanced/a86006757.eflt	/f18/flights/raaf/enhanced/a86006757.efat
/f18/flights/raaf/enhanced/a86006758.eflt	/f18/flights/raaf/enhanced/a86006758.efat
/f18/flights/raaf/enhanced/a86006763.eflt	/f18/flights/raaf/enhanced/a86006763.efat
/f18/flights/raaf/enhanced/a86006766.eflt	/f18/flights/raaf/enhanced/a86006766.efat
/f18/flights/raaf/enhanced/a86006767.eflt	/f18/flights/raaf/enhanced/a86006767.efat
/f18/flights/raaf/enhanced/a86006769.eflt	/f18/flights/raaf/enhanced/a86006769.efat
/f18/flights/raaf/enhanced/a86006770.eflt	/f18/flights/raaf/enhanced/a86006770.efat
/f18/flights/raaf/enhanced/a86006774.eflt	/f18/flights/raaf/enhanced/a86006774.efat
/f18/flights/raaf/enhanced/a86006775.eflt	/f18/flights/raaf/enhanced/a86006775.efat
/f18/flights/raaf/enhanced/a86006777.eflt	/f18/flights/raaf/enhanced/a86006777.efat
/f18/flights/raaf/enhanced/a86006778.eflt	/f18/flights/raaf/enhanced/a86006778.efat
/f18/flights/raaf/enhanced/a86006780.eflt	/f18/flights/raaf/enhanced/a86006780.efat
/f18/flights/raaf/enhanced/a86006782.eflt	/f18/flights/raaf/enhanced/a86006782.efat
/f18/flights/raaf/enhanced/a86006783.eflt	/f18/flights/raaf/enhanced/a86006783.efat
/f18/flights/raaf/enhanced/a86006784.eflt	/f18/flights/raaf/enhanced/a86006784.efat
/f18/flights/raaf/enhanced/a86006785.eflt	/f18/flights/raaf/enhanced/a86006785.efat
/f18/flights/raaf/enhanced/a86006786.eflt	/f18/flights/raaf/enhanced/a86006786.efat
/f18/flights/raaf/enhanced/a86006788.eflt	/f18/flights/raaf/enhanced/a86006788.efat
/f18/flights/raaf/enhanced/a86006790.eflt	/f18/flights/raaf/enhanced/a86006790.efat
/f18/flights/raaf/enhanced/a86006792.eflt	/f18/flights/raaf/enhanced/a86006792.efat
/f18/flights/raaf/enhanced/a86006797.eflt	/f18/flights/raaf/enhanced/a86006797.efat
/f18/flights/raaf/enhanced/a86006798.eflt	/f18/flights/raaf/enhanced/a86006798.efat
/f18/flights/raaf/enhanced/a86006800.eflt	/f18/flights/raaf/enhanced/a86006800.efat
/f18/flights/raaf/enhanced/a86004953.eflt	/f18/flights/raaf/enhanced/a86004953.efat
/f18/flights/raaf/enhanced/a86004954.eflt	/f18/flights/raaf/enhanced/a86004954.efat
/f18/flights/raaf/enhanced/a86004955.eflt	/f18/flights/raaf/enhanced/a86004955.efat
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/f18/flights/raaf/enhanced/a86004970.eflt	/f18/flights/raaf/enhanced/a86004970.efat
/f18/flights/raaf/enhanced/a86004971.eflt	/f18/flights/raaf/enhanced/a86004971.efat
/f18/flights/raaf/enhanced/a86004972.eflt	/f18/flights/raaf/enhanced/a86004972.efat
/f18/flights/raaf/enhanced/a86004973.eflt	/f18/flights/raaf/enhanced/a86004973.efat
/f18/flights/raaf/enhanced/a86004974.eflt	/f18/flights/raaf/enhanced/a86004974.efat
/f18/flights/raaf/enhanced/a86004975.eflt	/f18/flights/raaf/enhanced/a86004975.efat
/f18/flights/raaf/enhanced/a86004976.eflt	/f18/flights/raaf/enhanced/a86004976.efat
/f18/flights/raaf/enhanced/a86004979.eflt	/f18/flights/raaf/enhanced/a86004979.efat
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/f18/flights/raaf/enhanced/a86004984.eflt	/f18/flights/raaf/enhanced/a86004984.efat
/f18/flights/raaf/enhanced/a86004987.eflt	/f18/flights/raaf/enhanced/a86004987.efat
/f18/flights/raaf/enhanced/a86004988.eflt	/f18/flights/raaf/enhanced/a86004988.efat
/f18/flights/raaf/enhanced/a86004990.eflt	/f18/flights/raaf/enhanced/a86004990.efat
/f18/flights/raaf/enhanced/a86004993.eflt	/f18/flights/raaf/enhanced/a86004993.efat
/f18/flights/raaf/enhanced/a86004994.eflt	/f18/flights/raaf/enhanced/a86004994.efat
/f18/flights/raaf/enhanced/a86004995.eflt	/f18/flights/raaf/enhanced/a86004995.efat
/f18/flights/raaf/enhanced/a86004996.eflt	/f18/flights/raaf/enhanced/a86004996.efat
/f18/flights/raaf/enhanced/a86004997.eflt	/f18/flights/raaf/enhanced/a86004997.efat
/f18/flights/raaf/enhanced/a86004998.eflt	/f18/flights/raaf/enhanced/a86004998.efat
/f18/flights/raaf/enhanced/a86009751.eflt	/f18/flights/raaf/enhanced/a86009751.efat
/f18/flights/raaf/enhanced/a86009752.eflt	/f18/flights/raaf/enhanced/a86009752.efat
/f18/flights/raaf/enhanced/a86009753.eflt	/f18/flights/raaf/enhanced/a86009753.efat
/f18/flights/raaf/enhanced/a86009763.eflt	/f18/flights/raaf/enhanced/a86009763.efat
/f18/flights/raaf/enhanced/a86009768.eflt	/f18/flights/raaf/enhanced/a86009768.efat
/f18/flights/raaf/enhanced/a86009771.eflt	/f18/flights/raaf/enhanced/a86009771.efat
/f18/flights/raaf/enhanced/a86009778.eflt	/f18/flights/raaf/enhanced/a86009778.efat
/f18/flights/raaf/enhanced/a86009779.eflt	/f18/flights/raaf/enhanced/a86009779.efat
/f18/flights/raaf/enhanced/a86009780.eflt	/f18/flights/raaf/enhanced/a86009780.efat

Table 4 (cont.): Archived SPEC5 flight incident & fatigue records

/f18/flights/raaf/enhanced/a86009782.eflt	/f18/flights/raaf/enhanced/a86009782.efat
/f18/flights/raaf/enhanced/a86009783.eflt	/f18/flights/raaf/enhanced/a86009783.efat
/f18/flights/raaf/enhanced/a86009784.eflt	/f18/flights/raaf/enhanced/a86009784.efat
/f18/flights/raaf/enhanced/a86009785.eflt	/f18/flights/raaf/enhanced/a86009785.efat
/f18/flights/raaf/enhanced/a86009786.eflt	/f18/flights/raaf/enhanced/a86009786.efat
/f18/flights/raaf/enhanced/a86009787.eflt	/f18/flights/raaf/enhanced/a86009787.efat
/f18/flights/raaf/enhanced/a86009789.eflt	/f18/flights/raaf/enhanced/a86009789.efat
/f18/flights/raaf/enhanced/a86009790.eflt	/f18/flights/raaf/enhanced/a86009790.efat
/f18/flights/raaf/enhanced/a86009791.eflt	/f18/flights/raaf/enhanced/a86009791.efat
/f18/flights/raaf/enhanced/a86007302.eflt	/f18/flights/raaf/enhanced/a86007302.efat
/f18/flights/raaf/enhanced/a86007306.eflt	/f18/flights/raaf/enhanced/a86007306.efat
/f18/flights/raaf/enhanced/a86007308.eflt	/f18/flights/raaf/enhanced/a86007308.efat
/f18/flights/raaf/enhanced/a86007309.eflt	/f18/flights/raaf/enhanced/a86007309.efat
/f18/flights/raaf/enhanced/a86007311.eflt	/f18/flights/raaf/enhanced/a86007311.efat
/f18/flights/raaf/enhanced/a86007312.eflt	/f18/flights/raaf/enhanced/a86007312.efat
/f18/flights/raaf/enhanced/a86007313.eflt	/f18/flights/raaf/enhanced/a86007313.efat
/f18/flights/raaf/enhanced/a86007315.eflt	/f18/flights/raaf/enhanced/a86007315.efat
/f18/flights/raaf/enhanced/a86007319.eflt	/f18/flights/raaf/enhanced/a86007319.efat
/f18/flights/raaf/enhanced/a86007321.eflt	/f18/flights/raaf/enhanced/a86007321.efat
/f18/flights/raaf/enhanced/a86007322.eflt	/f18/flights/raaf/enhanced/a86007322.efat
/f18/flights/raaf/enhanced/a86007329.eflt	/f18/flights/raaf/enhanced/a86007329.efat
/f18/flights/raaf/enhanced/a86007332.eflt	/f18/flights/raaf/enhanced/a86007332.efat
/f18/flights/raaf/enhanced/a86007333.eflt	/f18/flights/raaf/enhanced/a86007333.efat
/f18/flights/raaf/enhanced/a86007335.eflt	/f18/flights/raaf/enhanced/a86007335.efat
/f18/flights/raaf/enhanced/a86007336.eflt	/f18/flights/raaf/enhanced/a86007336.efat
/f18/flights/raaf/enhanced/a86007337.eflt	/f18/flights/raaf/enhanced/a86007337.efat
/f18/flights/raaf/enhanced/a86007340.eflt	/f18/flights/raaf/enhanced/a86007340.efat
/f18/flights/raaf/enhanced/a86007342.eflt	/f18/flights/raaf/enhanced/a86007342.efat
/f18/flights/raaf/enhanced/a86003551.eflt	/f18/flights/raaf/enhanced/a86003551.efat
/f18/flights/raaf/enhanced/a86003552.eflt	/f18/flights/raaf/enhanced/a86003552.efat
/f18/flights/raaf/enhanced/a86003553.eflt	/f18/flights/raaf/enhanced/a86003553.efat
/f18/flights/raaf/enhanced/a86003555.eflt	/f18/flights/raaf/enhanced/a86003555.efat
/f18/flights/raaf/enhanced/a86003558.eflt	/f18/flights/raaf/enhanced/a86003558.efat
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/f18/flights/raaf/enhanced/a86003560.eflt	/f18/flights/raaf/enhanced/a86003560.efat
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/f18/flights/raaf/enhanced/a86003571.eflt	/f18/flights/raaf/enhanced/a86003571.efat
/f18/flights/raaf/enhanced/a86003573.eflt	/f18/flights/raaf/enhanced/a86003573.efat
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/f18/flights/raaf/enhanced/a86003577.eflt	/f18/flights/raaf/enhanced/a86003577.efat
/f18/flights/raaf/enhanced/a86003578.eflt	/f18/flights/raaf/enhanced/a86003578.efat
/f18/flights/raaf/enhanced/a86003588.eflt	/f18/flights/raaf/enhanced/a86003588.efat
/f18/flights/raaf/enhanced/a86003589.eflt	/f18/flights/raaf/enhanced/a86003589.efat
/f18/flights/raaf/enhanced/a86003591.eflt	/f18/flights/raaf/enhanced/a86003591.efat
/f18/flights/raaf/enhanced/a86003592.eflt	/f18/flights/raaf/enhanced/a86003592.efat
/f18/flights/raaf/enhanced/a86003593.eflt	/f18/flights/raaf/enhanced/a86003593.efat
/f18/flights/raaf/enhanced/a86003597.eflt	/f18/flights/raaf/enhanced/a86003597.efat
/f18/flights/raaf/enhanced/a86003598.eflt	/f18/flights/raaf/enhanced/a86003598.efat
/f18/flights/raaf/enhanced/a86003599.eflt	/f18/flights/raaf/enhanced/a86003599.efat
/f18/flights/raaf/enhanced/a86003600.eflt	/f18/flights/raaf/enhanced/a86003600.efat
/f18/flights/raaf/enhanced/a86016601.eflt	/f18/flights/raaf/enhanced/a86016601.efat
/f18/flights/raaf/enhanced/a86016604.eflt	/f18/flights/raaf/enhanced/a86016604.efat

Table 4 (cont.): Archived SPEC5 flight incident & fatigue records

/f18/flights/raaf/enhanced/a86016605.eflt	/f18/flights/raaf/enhanced/a86016605.efat
/f18/flights/raaf/enhanced/a86016608.eflt	/f18/flights/raaf/enhanced/a86016608.efat
/f18/flights/raaf/enhanced/a86016612.eflt	/f18/flights/raaf/enhanced/a86016612.efat
/f18/flights/raaf/enhanced/a86016617.eflt	/f18/flights/raaf/enhanced/a86016617.efat
/f18/flights/raaf/enhanced/a86016622.eflt	/f18/flights/raaf/enhanced/a86016622.efat
/f18/flights/raaf/enhanced/a86016624.eflt	/f18/flights/raaf/enhanced/a86016624.efat
/f18/flights/raaf/enhanced/a86016638.eflt	/f18/flights/raaf/enhanced/a86016638.efat
/f18/flights/raaf/enhanced/a86016639.eflt	/f18/flights/raaf/enhanced/a86016639.efat
/f18/flights/raaf/enhanced/a86016641.eflt	/f18/flights/raaf/enhanced/a86016641.efat
/f18/flights/raaf/enhanced/a86016642.eflt	/f18/flights/raaf/enhanced/a86016642.efat
/f18/flights/raaf/enhanced/a86016646.eflt	/f18/flights/raaf/enhanced/a86016646.efat
/f18/flights/raaf/enhanced/a86008203.eflt	/f18/flights/raaf/enhanced/a86008203.efat
/f18/flights/raaf/enhanced/a86008204.eflt	/f18/flights/raaf/enhanced/a86008204.efat
/f18/flights/raaf/enhanced/a86008206.eflt	/f18/flights/raaf/enhanced/a86008206.efat
/f18/flights/raaf/enhanced/a86008208.eflt	/f18/flights/raaf/enhanced/a86008208.efat
/f18/flights/raaf/enhanced/a86008209.eflt	/f18/flights/raaf/enhanced/a86008209.efat
/f18/flights/raaf/enhanced/a86008210.eflt	/f18/flights/raaf/enhanced/a86008210.efat
/f18/flights/raaf/enhanced/a86008212.eflt	/f18/flights/raaf/enhanced/a86008212.efat
/f18/flights/raaf/enhanced/a86008215.eflt	/f18/flights/raaf/enhanced/a86008215.efat
/f18/flights/raaf/enhanced/a86008216.eflt	/f18/flights/raaf/enhanced/a86008216.efat
/f18/flights/raaf/enhanced/a86008218.eflt	/f18/flights/raaf/enhanced/a86008218.efat
/f18/flights/raaf/enhanced/a86008220.eflt	/f18/flights/raaf/enhanced/a86008220.efat
/f18/flights/raaf/enhanced/a86008221.eflt	/f18/flights/raaf/enhanced/a86008221.efat
/f18/flights/raaf/enhanced/a86008225.eflt	/f18/flights/raaf/enhanced/a86008225.efat
/f18/flights/raaf/enhanced/a86008226.eflt	/f18/flights/raaf/enhanced/a86008226.efat
/f18/flights/raaf/enhanced/a86008228.eflt	/f18/flights/raaf/enhanced/a86008228.efat
/f18/flights/raaf/enhanced/a86008229.eflt	/f18/flights/raaf/enhanced/a86008229.efat
/f18/flights/raaf/enhanced/a86008231.eflt	/f18/flights/raaf/enhanced/a86008231.efat
/f18/flights/raaf/enhanced/a86008233.eflt	/f18/flights/raaf/enhanced/a86008233.efat
/f18/flights/raaf/enhanced/a86008234.eflt	/f18/flights/raaf/enhanced/a86008234.efat
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/f18/flights/raaf/enhanced/a87008247.eflt	/f18/flights/raaf/enhanced/a87008247.efat
/f18/flights/raaf/enhanced/a87008250.eflt	/f18/flights/raaf/enhanced/a87008250.efat
/f18/flights/raaf/enhanced/a87006451.eflt	/f18/flights/raaf/enhanced/a87006451.efat
/f18/flights/raaf/enhanced/a87006452.eflt	/f18/flights/raaf/enhanced/a87006452.efat
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/f18/flights/raaf/enhanced/a87006464.eflt	/f18/flights/raaf/enhanced/a87006464.efat
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/f18/flights/raaf/enhanced/a87006473.eflt	/f18/flights/raaf/enhanced/a87006473.efat
/f18/flights/raaf/enhanced/a87006477.eflt	/f18/flights/raaf/enhanced/a87006477.efat
/f18/flights/raaf/enhanced/a87006478.eflt	/f18/flights/raaf/enhanced/a87006478.efat
/f18/flights/raaf/enhanced/a87006484.eflt	/f18/flights/raaf/enhanced/a87006484.efat
/f18/flights/raaf/enhanced/a87006486.eflt	/f18/flights/raaf/enhanced/a87006486.efat
/f18/flights/raaf/enhanced/a87006487.eflt	/f18/flights/raaf/enhanced/a87006487.efat

Table 5: Archived SPEC5 statistical summary sheets

/f18/flights/raaf/summary/rfcs.1251	/f18/flights/raaf/summary/rfcf.1251
/f18/flights/raaf/summary/rfcs.1252	/f18/flights/raaf/summary/rfcf.1252
/f18/flights/raaf/summary/rfcs.1256	/f18/flights/raaf/summary/rfcf.1256
/f18/flights/raaf/summary/rfcs.1257	/f18/flights/raaf/summary/rfcf.1257
/f18/flights/raaf/summary/rfcs.1258	/f18/flights/raaf/summary/rfcf.1258
/f18/flights/raaf/summary/rfcs.1259	/f18/flights/raaf/summary/rfcf.1259
/f18/flights/raaf/summary/rfcs.1262	/f18/flights/raaf/summary/rfcf.1262
/f18/flights/raaf/summary/rfcs.1263	/f18/flights/raaf/summary/rfcf.1263
/f18/flights/raaf/summary/rfcs.1264	/f18/flights/raaf/summary/rfcf.1264
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/f18/flights/raaf/summary/rfcs.1266	/f18/flights/raaf/summary/rfcf.1266
/f18/flights/raaf/summary/rfcs.1267	/f18/flights/raaf/summary/rfcf.1267
/f18/flights/raaf/summary/rfcs.1268	/f18/flights/raaf/summary/rfcf.1268
/f18/flights/raaf/summary/rfcs.1269	/f18/flights/raaf/summary/rfcf.1269
/f18/flights/raaf/summary/rfcs.1272	/f18/flights/raaf/summary/rfcf.1272
/f18/flights/raaf/summary/rfcs.1274	/f18/flights/raaf/summary/rfcf.1274
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/f18/flights/raaf/summary/rfcs.1276	/f18/flights/raaf/summary/rfcf.1276
/f18/flights/raaf/summary/rfcs.1278	/f18/flights/raaf/summary/rfcf.1278
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/f18/flights/raaf/summary/rfcs.1281	/f18/flights/raaf/summary/rfcf.1281
/f18/flights/raaf/summary/rfcs.1282	/f18/flights/raaf/summary/rfcf.1282
/f18/flights/raaf/summary/rfcs.1285	/f18/flights/raaf/summary/rfcf.1285
/f18/flights/raaf/summary/rfcs.1287	/f18/flights/raaf/summary/rfcf.1287
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/f18/flights/raaf/summary/rfcs.1504	/f18/flights/raaf/summary/rfcf.1504
/f18/flights/raaf/summary/rfcs.1505	/f18/flights/raaf/summary/rfcf.1505
/f18/flights/raaf/summary/rfcs.1506	/f18/flights/raaf/summary/rfcf.1506
/f18/flights/raaf/summary/rfcs.1507	/f18/flights/raaf/summary/rfcf.1507
/f18/flights/raaf/summary/rfcs.1510	/f18/flights/raaf/summary/rfcf.1510
/f18/flights/raaf/summary/rfcs.1512	/f18/flights/raaf/summary/rfcf.1512
/f18/flights/raaf/summary/rfcs.1514	/f18/flights/raaf/summary/rfcf.1514
/f18/flights/raaf/summary/rfcs.1517	/f18/flights/raaf/summary/rfcf.1517
/f18/flights/raaf/summary/rfcs.1518	/f18/flights/raaf/summary/rfcf.1518
/f18/flights/raaf/summary/rfcs.1520	/f18/flights/raaf/summary/rfcf.1520
/f18/flights/raaf/summary/rfcs.1521	/f18/flights/raaf/summary/rfcf.1521
/f18/flights/raaf/summary/rfcs.1522	/f18/flights/raaf/summary/rfcf.1522
/f18/flights/raaf/summary/rfcs.1523	/f18/flights/raaf/summary/rfcf.1523
/f18/flights/raaf/summary/rfcs.1524	/f18/flights/raaf/summary/rfcf.1524
/f18/flights/raaf/summary/rfcs.1529	/f18/flights/raaf/summary/rfcf.1529
/f18/flights/raaf/summary/rfcs.1530	/f18/flights/raaf/summary/rfcf.1530
/f18/flights/raaf/summary/rfcs.1531	/f18/flights/raaf/summary/rfcf.1531
/f18/flights/raaf/summary/rfcs.1534	/f18/flights/raaf/summary/rfcf.1534
/f18/flights/raaf/summary/rfcs.1535	/f18/flights/raaf/summary/rfcf.1535
/f18/flights/raaf/summary/rfcs.1536	/f18/flights/raaf/summary/rfcf.1536
/f18/flights/raaf/summary/rfcs.1538	/f18/flights/raaf/summary/rfcf.1538
/f18/flights/raaf/summary/rfcs.1539	/f18/flights/raaf/summary/rfcf.1539
/f18/flights/raaf/summary/rfcs.1540	/f18/flights/raaf/summary/rfcf.1540
/f18/flights/raaf/summary/rfcs.1542	/f18/flights/raaf/summary/rfcf.1542
/f18/flights/raaf/summary/rfcs.1543	/f18/flights/raaf/summary/rfcf.1543
/f18/flights/raaf/summary/rfcs.1544	/f18/flights/raaf/summary/rfcf.1544
/f18/flights/raaf/summary/rfcs.1545	/f18/flights/raaf/summary/rfcf.1545
/f18/flights/raaf/summary/rfcs.1546	/f18/flights/raaf/summary/rfcf.1546
/f18/flights/raaf/summary/rfcs.1548	/f18/flights/raaf/summary/rfcf.1548
/f18/flights/raaf/summary/rfcs.1549	/f18/flights/raaf/summary/rfcf.1549
/f18/flights/raaf/summary/rfcs.1550	/f18/flights/raaf/summary/rfcf.1550
/f18/flights/raaf/summary/rfcs.2856	/f18/flights/raaf/summary/rfcf.2856
/f18/flights/raaf/summary/rfcs.2857	/f18/flights/raaf/summary/rfcf.2857
/f18/flights/raaf/summary/rfcs.2858	/f18/flights/raaf/summary/rfcf.2858

Table 5 (cont.): Archived SPEC5 statistical summary sheets

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/f18/flights/raaf/summary/rfcs.2864	/f18/flights/raaf/summary/rfcf.2864
/f18/flights/raaf/summary/rfcs.2866	/f18/flights/raaf/summary/rfcf.2866
/f18/flights/raaf/summary/rfcs.2867	/f18/flights/raaf/summary/rfcf.2867
/f18/flights/raaf/summary/rfcs.2868	/f18/flights/raaf/summary/rfcf.2868
/f18/flights/raaf/summary/rfcs.2870	/f18/flights/raaf/summary/rfcf.2870
/f18/flights/raaf/summary/rfcs.2875	/f18/flights/raaf/summary/rfcf.2875
/f18/flights/raaf/summary/rfcs.2876_I	/f18/flights/raaf/summary/rfcf.2876_I
/f18/flights/raaf/summary/rfcs.2876_II	/f18/flights/raaf/summary/rfcf.2876_II
/f18/flights/raaf/summary/rfcs.2877	/f18/flights/raaf/summary/rfcf.2877
/f18/flights/raaf/summary/rfcs.2878	/f18/flights/raaf/summary/rfcf.2878
/f18/flights/raaf/summary/rfcs.2880	/f18/flights/raaf/summary/rfcf.2880
/f18/flights/raaf/summary/rfcs.2886	/f18/flights/raaf/summary/rfcf.2886
/f18/flights/raaf/summary/rfcs.2887	/f18/flights/raaf/summary/rfcf.2887
/f18/flights/raaf/summary/rfcs.2890	/f18/flights/raaf/summary/rfcf.2890
/f18/flights/raaf/summary/rfcs.2891	/f18/flights/raaf/summary/rfcf.2891
/f18/flights/raaf/summary/rfcs.3551	/f18/flights/raaf/summary/rfcf.3551
/f18/flights/raaf/summary/rfcs.3552	/f18/flights/raaf/summary/rfcf.3552
/f18/flights/raaf/summary/rfcs.3553	/f18/flights/raaf/summary/rfcf.3553
/f18/flights/raaf/summary/rfcs.3555	/f18/flights/raaf/summary/rfcf.3555
/f18/flights/raaf/summary/rfcs.3558	/f18/flights/raaf/summary/rfcf.3558
/f18/flights/raaf/summary/rfcs.3559	/f18/flights/raaf/summary/rfcf.3559
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/f18/flights/raaf/summary/rfcs.3565	/f18/flights/raaf/summary/rfcf.3565
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/f18/flights/raaf/summary/rfcs.3567	/f18/flights/raaf/summary/rfcf.3567
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/f18/flights/raaf/summary/rfcs.3571	/f18/flights/raaf/summary/rfcf.3571
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/f18/flights/raaf/summary/rfcs.3578	/f18/flights/raaf/summary/rfcf.3578
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/f18/flights/raaf/summary/rfcs.3592	/f18/flights/raaf/summary/rfcf.3592
/f18/flights/raaf/summary/rfcs.3593	/f18/flights/raaf/summary/rfcf.3593
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/f18/flights/raaf/summary/rfcs.4452	/f18/flights/raaf/summary/rfcf.4452
/f18/flights/raaf/summary/rfcs.4458_I	/f18/flights/raaf/summary/rfcf.4458_I
/f18/flights/raaf/summary/rfcs.4458_II	/f18/flights/raaf/summary/rfcf.4458_II
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/f18/flights/raaf/summary/rfcs.4473	/f18/flights/raaf/summary/rfcf.4473
/f18/flights/raaf/summary/rfcs.4475	/f18/flights/raaf/summary/rfcf.4475
/f18/flights/raaf/summary/rfcs.4476	/f18/flights/raaf/summary/rfcf.4476
/f18/flights/raaf/summary/rfcs.4477	/f18/flights/raaf/summary/rfcf.4477
/f18/flights/raaf/summary/rfcs.4480	/f18/flights/raaf/summary/rfcf.4480

Table 5 (cont.): Archived SPEC5 statistical summary sheets

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/f18/flights/raaf/summary/rfcs.4483	/f18/flights/raaf/summary/rfcf.4483
/f18/flights/raaf/summary/rfcs.4484	/f18/flights/raaf/summary/rfcf.4484
/f18/flights/raaf/summary/rfcs.4488	/f18/flights/raaf/summary/rfcf.4488
/f18/flights/raaf/summary/rfcs.4489	/f18/flights/raaf/summary/rfcf.4489
/f18/flights/raaf/summary/rfcs.4491	/f18/flights/raaf/summary/rfcf.4491
/f18/flights/raaf/summary/rfcs.4493	/f18/flights/raaf/summary/rfcf.4493
/f18/flights/raaf/summary/rfcs.4494	/f18/flights/raaf/summary/rfcf.4494
/f18/flights/raaf/summary/rfcs.4495	/f18/flights/raaf/summary/rfcf.4495
/f18/flights/raaf/summary/rfcs.4497	/f18/flights/raaf/summary/rfcf.4497
/f18/flights/raaf/summary/rfcs.4953	/f18/flights/raaf/summary/rfcf.4953
/f18/flights/raaf/summary/rfcs.4954	/f18/flights/raaf/summary/rfcf.4954
/f18/flights/raaf/summary/rfcs.4955	/f18/flights/raaf/summary/rfcf.4955
/f18/flights/raaf/summary/rfcs.4956	/f18/flights/raaf/summary/rfcf.4956
/f18/flights/raaf/summary/rfcs.4958	/f18/flights/raaf/summary/rfcf.4958
/f18/flights/raaf/summary/rfcs.4959	/f18/flights/raaf/summary/rfcf.4959
/f18/flights/raaf/summary/rfcs.4970	/f18/flights/raaf/summary/rfcf.4970
/f18/flights/raaf/summary/rfcs.4971	/f18/flights/raaf/summary/rfcf.4971
/f18/flights/raaf/summary/rfcs.4972	/f18/flights/raaf/summary/rfcf.4972
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/f18/flights/raaf/summary/rfcs.4974	/f18/flights/raaf/summary/rfcf.4974
/f18/flights/raaf/summary/rfcs.4975	/f18/flights/raaf/summary/rfcf.4975
/f18/flights/raaf/summary/rfcs.4976	/f18/flights/raaf/summary/rfcf.4976
/f18/flights/raaf/summary/rfcs.4979	/f18/flights/raaf/summary/rfcf.4979
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/f18/flights/raaf/summary/rfcs.4984	/f18/flights/raaf/summary/rfcf.4984
/f18/flights/raaf/summary/rfcs.4987	/f18/flights/raaf/summary/rfcf.4987
/f18/flights/raaf/summary/rfcs.4988	/f18/flights/raaf/summary/rfcf.4988
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/f18/flights/raaf/summary/rfcs.4993	/f18/flights/raaf/summary/rfcf.4993
/f18/flights/raaf/summary/rfcs.4994	/f18/flights/raaf/summary/rfcf.4994
/f18/flights/raaf/summary/rfcs.4995	/f18/flights/raaf/summary/rfcf.4995
/f18/flights/raaf/summary/rfcs.4996	/f18/flights/raaf/summary/rfcf.4996
/f18/flights/raaf/summary/rfcs.4997	/f18/flights/raaf/summary/rfcf.4997
/f18/flights/raaf/summary/rfcs.4998	/f18/flights/raaf/summary/rfcf.4998
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/f18/flights/raaf/summary/rfcs.6452	/f18/flights/raaf/summary/rfcf.6452
/f18/flights/raaf/summary/rfcs.6455	/f18/flights/raaf/summary/rfcf.6455
/f18/flights/raaf/summary/rfcs.6462	/f18/flights/raaf/summary/rfcf.6462
/f18/flights/raaf/summary/rfcs.6464	/f18/flights/raaf/summary/rfcf.6464
/f18/flights/raaf/summary/rfcs.6466	/f18/flights/raaf/summary/rfcf.6466
/f18/flights/raaf/summary/rfcs.6467	/f18/flights/raaf/summary/rfcf.6467
/f18/flights/raaf/summary/rfcs.6469	/f18/flights/raaf/summary/rfcf.6469
/f18/flights/raaf/summary/rfcs.6471	/f18/flights/raaf/summary/rfcf.6471
/f18/flights/raaf/summary/rfcs.6473	/f18/flights/raaf/summary/rfcf.6473
/f18/flights/raaf/summary/rfcs.6477	/f18/flights/raaf/summary/rfcf.6477
/f18/flights/raaf/summary/rfcs.6478	/f18/flights/raaf/summary/rfcf.6478
/f18/flights/raaf/summary/rfcs.6484	/f18/flights/raaf/summary/rfcf.6484
/f18/flights/raaf/summary/rfcs.6486	/f18/flights/raaf/summary/rfcf.6486
/f18/flights/raaf/summary/rfcs.6487	/f18/flights/raaf/summary/rfcf.6487
/f18/flights/raaf/summary/rfcs.6601	/f18/flights/raaf/summary/rfcf.6601
/f18/flights/raaf/summary/rfcs.6604	/f18/flights/raaf/summary/rfcf.6604
/f18/flights/raaf/summary/rfcs.6605	/f18/flights/raaf/summary/rfcf.6605
/f18/flights/raaf/summary/rfcs.6608	/f18/flights/raaf/summary/rfcf.6608
/f18/flights/raaf/summary/rfcs.6612	/f18/flights/raaf/summary/rfcf.6612
/f18/flights/raaf/summary/rfcs.6617	/f18/flights/raaf/summary/rfcf.6617
/f18/flights/raaf/summary/rfcs.6622	/f18/flights/raaf/summary/rfcf.6622
/f18/flights/raaf/summary/rfcs.6624	/f18/flights/raaf/summary/rfcf.6624
/f18/flights/raaf/summary/rfcs.6638	/f18/flights/raaf/summary/rfcf.6638
/f18/flights/raaf/summary/rfcs.6639	/f18/flights/raaf/summary/rfcf.6639
/f18/flights/raaf/summary/rfcs.6641	/f18/flights/raaf/summary/rfcf.6641

Table 5 (cont.): Archived SPEC5 statistical summary sheets

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/f18/flights/raaf/summary/rfcs.6756	/f18/flights/raaf/summary/rfcf.6756
/f18/flights/raaf/summary/rfcs.6757	/f18/flights/raaf/summary/rfcf.6757
/f18/flights/raaf/summary/rfcs.6758	/f18/flights/raaf/summary/rfcf.6758
/f18/flights/raaf/summary/rfcs.6763	/f18/flights/raaf/summary/rfcf.6763
/f18/flights/raaf/summary/rfcs.6766	/f18/flights/raaf/summary/rfcf.6766
/f18/flights/raaf/summary/rfcs.6767	/f18/flights/raaf/summary/rfcf.6767
/f18/flights/raaf/summary/rfcs.6769_I	/f18/flights/raaf/summary/rfcf.6769_I
/f18/flights/raaf/summary/rfcs.6769_II	/f18/flights/raaf/summary/rfcf.6769_II
/f18/flights/raaf/summary/rfcs.6770	/f18/flights/raaf/summary/rfcf.6770
/f18/flights/raaf/summary/rfcs.6774	/f18/flights/raaf/summary/rfcf.6774
/f18/flights/raaf/summary/rfcs.6775	/f18/flights/raaf/summary/rfcf.6775
/f18/flights/raaf/summary/rfcs.6777	/f18/flights/raaf/summary/rfcf.6777
/f18/flights/raaf/summary/rfcs.6778	/f18/flights/raaf/summary/rfcf.6778
/f18/flights/raaf/summary/rfcs.6780	/f18/flights/raaf/summary/rfcf.6780
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/f18/flights/raaf/summary/rfcs.6783	/f18/flights/raaf/summary/rfcf.6783
/f18/flights/raaf/summary/rfcs.6784	/f18/flights/raaf/summary/rfcf.6784
/f18/flights/raaf/summary/rfcs.6785	/f18/flights/raaf/summary/rfcf.6785
/f18/flights/raaf/summary/rfcs.6786	/f18/flights/raaf/summary/rfcf.6786
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/f18/flights/raaf/summary/rfcs.6797	/f18/flights/raaf/summary/rfcf.6797
/f18/flights/raaf/summary/rfcs.6798	/f18/flights/raaf/summary/rfcf.6798
/f18/flights/raaf/summary/rfcs.6800	/f18/flights/raaf/summary/rfcf.6800
/f18/flights/raaf/summary/rfcs.7302	/f18/flights/raaf/summary/rfcf.7302
/f18/flights/raaf/summary/rfcs.7306	/f18/flights/raaf/summary/rfcf.7306
/f18/flights/raaf/summary/rfcs.7308	/f18/flights/raaf/summary/rfcf.7308
/f18/flights/raaf/summary/rfcs.7309	/f18/flights/raaf/summary/rfcf.7309
/f18/flights/raaf/summary/rfcs.7311	/f18/flights/raaf/summary/rfcf.7311
/f18/flights/raaf/summary/rfcs.7312	/f18/flights/raaf/summary/rfcf.7312
/f18/flights/raaf/summary/rfcs.7313	/f18/flights/raaf/summary/rfcf.7313
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/f18/flights/raaf/summary/rfcs.7321	/f18/flights/raaf/summary/rfcf.7321
/f18/flights/raaf/summary/rfcs.7322	/f18/flights/raaf/summary/rfcf.7322
/f18/flights/raaf/summary/rfcs.7329	/f18/flights/raaf/summary/rfcf.7329
/f18/flights/raaf/summary/rfcs.7332	/f18/flights/raaf/summary/rfcf.7332
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/f18/flights/raaf/summary/rfcs.7336	/f18/flights/raaf/summary/rfcf.7336
/f18/flights/raaf/summary/rfcs.7337	/f18/flights/raaf/summary/rfcf.7337
/f18/flights/raaf/summary/rfcs.7340	/f18/flights/raaf/summary/rfcf.7340
/f18/flights/raaf/summary/rfcs.7342	/f18/flights/raaf/summary/rfcf.7342
/f18/flights/raaf/summary/rfcs.8203	/f18/flights/raaf/summary/rfcf.8203
/f18/flights/raaf/summary/rfcs.8204	/f18/flights/raaf/summary/rfcf.8204
/f18/flights/raaf/summary/rfcs.8206	/f18/flights/raaf/summary/rfcf.8206
/f18/flights/raaf/summary/rfcs.8208	/f18/flights/raaf/summary/rfcf.8208
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/f18/flights/raaf/summary/rfcs.8212	/f18/flights/raaf/summary/rfcf.8212
/f18/flights/raaf/summary/rfcs.8215	/f18/flights/raaf/summary/rfcf.8215
/f18/flights/raaf/summary/rfcs.8216	/f18/flights/raaf/summary/rfcf.8216
/f18/flights/raaf/summary/rfcs.8218	/f18/flights/raaf/summary/rfcf.8218
/f18/flights/raaf/summary/rfcs.8220	/f18/flights/raaf/summary/rfcf.8220
/f18/flights/raaf/summary/rfcs.8221	/f18/flights/raaf/summary/rfcf.8221
/f18/flights/raaf/summary/rfcs.8225	/f18/flights/raaf/summary/rfcf.8225
/f18/flights/raaf/summary/rfcs.8226	/f18/flights/raaf/summary/rfcf.8226
/f18/flights/raaf/summary/rfcs.8228	/f18/flights/raaf/summary/rfcf.8228

Table 5 (cont.): Archived SPEC5 statistical summary sheets

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/f18/flights/raaf/summary/rfcs.8231	/f18/flights/raaf/summary/rfcf.8231
/f18/flights/raaf/summary/rfcs.8233	/f18/flights/raaf/summary/rfcf.8233
/f18/flights/raaf/summary/rfcs.8234	/f18/flights/raaf/summary/rfcf.8234
/f18/flights/raaf/summary/rfcs.8246	/f18/flights/raaf/summary/rfcf.8246
/f18/flights/raaf/summary/rfcs.8247	/f18/flights/raaf/summary/rfcf.8247
/f18/flights/raaf/summary/rfcs.8250	/f18/flights/raaf/summary/rfcf.8250
/f18/flights/raaf/summary/rfcs.9552	/f18/flights/raaf/summary/rfcf.9552
/f18/flights/raaf/summary/rfcs.9555	/f18/flights/raaf/summary/rfcf.9555
/f18/flights/raaf/summary/rfcs.9557	/f18/flights/raaf/summary/rfcf.9557
/f18/flights/raaf/summary/rfcs.9558	/f18/flights/raaf/summary/rfcf.9558
/f18/flights/raaf/summary/rfcs.9559	/f18/flights/raaf/summary/rfcf.9559
/f18/flights/raaf/summary/rfcs.9560	/f18/flights/raaf/summary/rfcf.9560
/f18/flights/raaf/summary/rfcs.9561	/f18/flights/raaf/summary/rfcf.9561
/f18/flights/raaf/summary/rfcs.9562	/f18/flights/raaf/summary/rfcf.9562
/f18/flights/raaf/summary/rfcs.9566	/f18/flights/raaf/summary/rfcf.9566
/f18/flights/raaf/summary/rfcs.9572	/f18/flights/raaf/summary/rfcf.9572
/f18/flights/raaf/summary/rfcs.9576	/f18/flights/raaf/summary/rfcf.9576
/f18/flights/raaf/summary/rfcs.9577	/f18/flights/raaf/summary/rfcf.9577
/f18/flights/raaf/summary/rfcs.9578	/f18/flights/raaf/summary/rfcf.9578
/f18/flights/raaf/summary/rfcs.9579	/f18/flights/raaf/summary/rfcf.9579
/f18/flights/raaf/summary/rfcs.9580	/f18/flights/raaf/summary/rfcf.9580
/f18/flights/raaf/summary/rfcs.9586	/f18/flights/raaf/summary/rfcf.9586
/f18/flights/raaf/summary/rfcs.9587	/f18/flights/raaf/summary/rfcf.9587
/f18/flights/raaf/summary/rfcs.9588_I	/f18/flights/raaf/summary/rfcf.9588_I
/f18/flights/raaf/summary/rfcs.9588_II	/f18/flights/raaf/summary/rfcf.9588_II
/f18/flights/raaf/summary/rfcs.9589	/f18/flights/raaf/summary/rfcf.9589
/f18/flights/raaf/summary/rfcs.9590	/f18/flights/raaf/summary/rfcf.9590
/f18/flights/raaf/summary/rfcs.9596	/f18/flights/raaf/summary/rfcf.9596
/f18/flights/raaf/summary/rfcs.9597	/f18/flights/raaf/summary/rfcf.9597
/f18/flights/raaf/summary/rfcs.9751	/f18/flights/raaf/summary/rfcf.9751
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/f18/flights/raaf/summary/rfcs.9753	/f18/flights/raaf/summary/rfcf.9753
/f18/flights/raaf/summary/rfcs.9763	/f18/flights/raaf/summary/rfcf.9763
/f18/flights/raaf/summary/rfcs.9768	/f18/flights/raaf/summary/rfcf.9768
/f18/flights/raaf/summary/rfcs.9771	/f18/flights/raaf/summary/rfcf.9771
/f18/flights/raaf/summary/rfcs.9778_I	/f18/flights/raaf/summary/rfcf.9778_I
/f18/flights/raaf/summary/rfcs.9778_II	/f18/flights/raaf/summary/rfcf.9778_II
/f18/flights/raaf/summary/rfcs.9779	/f18/flights/raaf/summary/rfcf.9779
/f18/flights/raaf/summary/rfcs.9780	/f18/flights/raaf/summary/rfcf.9780
/f18/flights/raaf/summary/rfcs.9782	/f18/flights/raaf/summary/rfcf.9782
/f18/flights/raaf/summary/rfcs.9783	/f18/flights/raaf/summary/rfcf.9783
/f18/flights/raaf/summary/rfcs.9784_I	/f18/flights/raaf/summary/rfcf.9784_I
/f18/flights/raaf/summary/rfcs.9784_II	/f18/flights/raaf/summary/rfcf.9784_II
/f18/flights/raaf/summary/rfcs.9785_I	/f18/flights/raaf/summary/rfcf.9785_I
/f18/flights/raaf/summary/rfcs.9785_II	/f18/flights/raaf/summary/rfcf.9785_II
/f18/flights/raaf/summary/rfcs.9786	/f18/flights/raaf/summary/rfcf.9786
/f18/flights/raaf/summary/rfcs.9787_I	/f18/flights/raaf/summary/rfcf.9787_I
/f18/flights/raaf/summary/rfcs.9787_II	/f18/flights/raaf/summary/rfcf.9787_II
/f18/flights/raaf/summary/rfcs.9789_I	/f18/flights/raaf/summary/rfcf.9789_I
/f18/flights/raaf/summary/rfcs.9789_II	/f18/flights/raaf/summary/rfcf.9789_II
/f18/flights/raaf/summary/rfcs.9790	/f18/flights/raaf/summary/rfcf.9790
/f18/flights/raaf/summary/rfcs.9791	/f18/flights/raaf/summary/rfcf.9791

Table 6: Archived software used in the enhancement of SPEC5 data

```
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/f18/flights/raaf/programs/fpr
/f18/flights/raaf/programs/rfcs85
/f18/flights/raaf/programs/rfcf85
/f18/flights/raaf/programs/f182bin
/f18/flights/raaf/programs/f18rfc.exe
/f18/flights/raaf/programs/f18init.com
```

Table 7: A summary of the processed SPEC5 MSDRS data

Flt. No.	Processed Time		Time Jump		Period	Total Time
	Start	End	Start	End	(s)	(s)
a86001251	13218	14573				1355
a86001252	16518	19008				2490
a86001256	28496	30196	29501	29506	5	1695
a86001257	32499	34484				1985
a86001258	36395	38760				2365
a86001259	39998	42793				2795
a86001262	56596	59841				3245
a86001263	61401	64581	62157	62167	10	3170
a86001264	66166	68086				1920
a86001265	3971	5826				1855
a86001266	7279	9829				2550
a86001267	11597	13447				1850
a86001268	14711	16626				1915
a86001269	18167	19862				1695
a86001272	22872	24692				1820
a86001274	29557	31497				1940
a86001275	33062	34967				1905
a86001276	36721	38031				1310
a86001278	45408	48243				2835
a86001279	49606	51801				2195
a86001281	53874	56429	54614 54694	54674 54729	60 35	 2460
a86001282	57776	59991	58991	59001	10	2205
a86001285	8298	10653	9488	9493	5	2350
a86001287	12945	15390	13575	13610	35	2410
a86001291	23168	25658				2490
a86001293	28287	30422				2135
a86001501	53700	59465				5765
a86001504	3903	5383				1480
a86001505	6913 9678	9783 9813	9618	9623	5	2865 135
a86001506	12130	15115	15465	15470	5	2985
a86001507	18598	21853				3255
a86001510	28346	30306				1960

Table 7 (cont.): A summary of the processed SPEC5 MSDRS data

Flt. No.	Processed Time		Time Jump		Period	Total Time
	Start	End	Start	End	(s)	(s)
a86001512	1291	3166	1691	1696	5	1870
a86001514	4440	8115				3675
a86001517	17214	18909				1695
a86001518	20623	22603				1980
a86001520	27271	29476				2205
a86001521	30797	32947	33377	33382	5	2150
a86001522	36144	38144				2000
a86001523	40003	41808				1805
a86001524	43843	45053				1210
a86001529	54672	56612				1940
a86001530	57984	59544				1560
a86001531	60873	62653	61893	61923	30	1750
a86001534	1019	5379	1809	1864	55	
			2399	2404	5	4300
a86001535	7527	11237				3710
a86001536	12661	14291	13571	13621	50	1580
a86001538	21213	25213	22693	22698	5	3995
a86001539	26993	31433	27678	27768	90	4350
a86001540	33327	35877				2550
a86001542	40860	43865	43195	43200	5	3000
a86001543	44996	47701	45631	45651	20	2685
a86001544	48832	50997				2165
a86001545	52962	56062				3100
a86001546	57267	59947				2680
	59957	59992				35
a86001548	64918	68023				3105
a86001549	5242	7212				1970
a86001550	8559	11169				2610
	11224	11414				190
a86002856	45035	46880				1845
	47045	47380				335
a86002857	50391	52211				1820
a86002858	54798	56168				1370
	56288	56888				600
a86002859	60271	61661				1390

Table 7 (cont.): A summary of the processed SPEC5 MSDRS data

Flt. No.	Processed Time		Time Jump		Period	Total Time
	Start	End	Start	End	(s)	(s)
a86002861	63257	66802	65147	65172	25	3520
a86002864	4045	6130				2085
a86002866	10944	13124				2180
a86002867	14442	16452				2010
a86002868	17910	19690	18415	18420	5	
			19360	19365	5	1770
a86002870	25084	26259				1175
a86002875	33311	35016				1705
a86002876						
Part I	36619	38054				1435
Part II	38464	40079	38809	38814	5	1610
	40329	40569				240
a86002877	43014	45044				2030
a86002878	46369	48309	47434	47439	5	1935
a86002880	49772	51937	50322	50327	5	2160
a86002886	62142	65587				3445
a86002887	2085	5590				3505
a86002890	13599	15354	14514	14510	5	
			14894	14899	5	
			15029	15039	10	1735
a86002891	28438	34018				5580
a86003551	1242	2937				1695
a86003552	5244	7649				2405
a86003553	9028	11533				2505
a86003555	13302	15812				2510
a86003558	19471	21901				2430
a86003559	23113	25528				2415
a86003560	27551	29836	28151	28156	5	2280
a86003561	30967	33117				2150
a86003562	34827	38472				3645
a86003564	40696	44171	42091	42096	5	3470
a86003565	46309	49874				3565
a86003566	51228	53858				2630
a86003567	54964	56734				1770
a86003568	58744	62449				3705

Table 7 (cont.): A summary of the processed SPEC5 MSDRS data

Flt. No.	Processed Time		Time Jump		Period	Total Time
	Start	End	Start	End	(s)	(s)
a86003570	63960	65995	65380	65385	5	2030
a86003571	2566	6976				4410
a86003573	14963	19858				4895
a86003574	21055	23250	22415	22420	5	2190
a86003576	24502	28397				3895
a86003577	30151	33446				3295
a86003578	36089	40279				4190
a86003588	14675	17045				2370
a86003589	18479	21039				2560
a86003591	23184	25734	23679	23744	65	2485
a86003592	27660	30100				2440
a86003593	31755	32875				1120
a86003597	35952	38742	36317	36322	5	
			36792	36797	5	2780
a86003598	40283	41813				1530
	41823	42963				1080
a86003599	44909	47614				2705
a86003600	50436	53536	53161	53166	5	3095
a86004452	20598	22668				2070
	22668	22678				10
a86004458						
Part I	45907	49367				3460
Part II	49407	50492				1085
a86004461	61731	66716				4985
a86004467	11498	12873				1375
a86004468	14660	18180	17555	17560	5	3515
a86004469	19529	21624				2095
a86004470	24754	28074				3320
a86004471	30444	30494				50
	30564	35824	33554	33559	5	
			33839	33879	40	5215
a86004473	38001	41966				3965
a86004475	44229	48939				4710
a86004476	51708	56328				4620
a86004477	57881	62071	59081	59106	25	4165

Table 7 (cont.): A summary of the processed SPEC5 MSDRS data

Flt. No.	Processed Time		Time Jump		Period	Total Time
	Start	End	Start	End	(s)	(s)
a86004480	6497	9997	7092	7172	80	3420
a86004481	11874	15334				3460
a86004483	17088	21763	20268	20273	5	4670
a86004484	25975	30375				4400
a86004488	45523	49013				3490
a86004489	51241	55991	52996	53056	60	4690
a86004491	59095	64255	64025	64030	5	5155
a86004493	4433	7088				2655
	7138	9543				2405
a86004494	13387	18442				5055
a86004495	19606	24791				5185
a86004497	28491	30286				1795
a86004953	34506	36696				2190
a86004954	38294	40139				1845
a86004955	42379	44589				2210
a86004956	45907	48347				2440
a86004958	50090	52590				2500
a86004959	55099	57034				1935
a86004970	65343	72133				6790
a86004971	7930	14125				6195
a86004972	16154	18144	17294	17329	35	2100
a86004973	19880	21565				1685
a86004974	23194	25124	23779	23784	5	1925
a86004975	26812	28137				1325
a86004976	29917	32842	32327	32332	5	2920
a86004979	35324	37844	37119	37164	45	2475
a86004983	41375	44160				2785
a86004984	46508	48768				2260
a86004987	53149	57039				3890
a86004988	58703	62553				3850
a86004990	65490	67410				1920
a86004993	5740	9645				3905
a86004994	12406	16266				3860
a86004995	17681	20356	20006	20081	75	
			20176	20246	70	2675

Table 7 (cont.): A summary of the processed SPEC5 MSDRS data

Flt. No.	Processed Time		Time Jump		Period	Total Time
	Start	End	Start	End	(s)	(s)
a86004996	23239	27029	25979	26009	30	
			26424	26429	5	3755
a86004997	29124	31519	31114	31119	5	2390
a86004998	33870	38155	35385	35390	5	
			35645	35650	5	
			38020	38025	5	4270
a86006756	3852	11387	9507	9547	40	7495
a86006757	12624	18244				5620
a86006758	19748	22193				2445
a86006763	29301	32711				3410
a86006766	42957	46352				3395
a86006767	48483	50443				1960
a86006769						
Part I	57948	59828				1880
Part II	59928	60858				930
a86006770	61989	64864				2875
a86006774	4749	6449	5109	5119	10	1690
a86006775	8720	11385				2665
a86006777	19091	21996	20806	20811	5	2900
a86006778	23369	25914				2545
a86006780	29121	33146				4025
a86006782	40888	44953	42238	42243	5	
			42598	42603	5	4055
a86006783	46312	49137				2825
a86006784	50574	52574	51359	51364	5	1995
a86006785	54125	55955				1830
a86006786	57171	58591				1420
a86006788	60422	62387	61977	61982	5	1960
a86006790	3358	7108				3570
a86006792	9944	12089				2145
a86006797	9509	11199				1690
a86006798	15987	18002	17647	17652	5	2010
a86006800	23189	24654				1465
a86007302	25968	29228				3260
a86007306	35729	38149				2420

Table 7 (cont.): A summary of the processed SPEC5 MSDRS data

Flt. No.	Processed Time		Time Jump		Period	Total Time
	Start	End	Start	End	(s)	(s)
a86007308	44554	46414	45314	45319	5	1855
a86007309	48728	50533				1805
a86007311	57804	60119	59119	59124	5	2310
a86007312	62829	65169	64559	64564	5	2335
a86007313	1502	3177	2622	2627	5	1670
a86007315	5136	7236				2100
a86007319	19223	20973				1750
a86007321	26557	28277	27582	27587	5	1715
a86007322	29470	31235				1765
a86007329	62698	64843	63948	63953	5	2140
a86007332	6665	9800				3135
	9800	9840				40
a86007333	11616	13371				1755
a86007335	15128	17068				1940
a86007336	19748	21593				1845
a86007337	22983	26588	26068	26103	35	3570
a86007340	29348	30813				1465
a86007342	32567	34662				2095
a86008203	39408	42308	41503	41533	30	2870
a86008204	44017	47587	44557	44562	5	3565
a86008206	49568	53183				3615
a86008208	54910	59430				4520
a86008209	60821	61761				940
a86008210	63060	64160				1100
a86008212	5611	9246	8711	8716	5	3630
a86008215	21177	25637	22707	22792	85	4375
a86008216	27792	31927				4135
a86008218	34233	39608	36058	36063	5	5370
a86008220	41348	44918	42983	42988	5	3565
a86008221	47052	50817				3765
a86008225	4258	7803				3545
a86008226	10019	13339				3320
a86008228	16013	21163				5150
a86008229	23679	29114				5435
a86008231	31669	36769				5100
a86008233	38397	42157	39472	39477	5	3755

Table 7 (cont.): A summary of the processed SPEC5 MSDRS data

Flt. No.	Processed Time		Time Jump		Period	Total Time
	Start	End	Start	End	(s)	(s)
a86008234	45279	50309				5030
a86009552	34218	38348				4130
a86009555	41761	46326				4565
a86009557	49432	52757				3325
a86009558	53954	56504				2550
	57199	57569				370
a86009559	59008	61793	59993	59998	5	2780
	62048	62093				45
a86009560	64281	64361	64321	64326	5	75
	65131	68241				3110
a86009561	4256	7691	7081	7131	50	3385
a86009562	9985	12400	10645	10715	70	2345
a86009566	26432	28902				2470
a86009572	38080	39535				1455
a86009576	4720	6290				1570
a86009577	9352	12032				2680
a86009578	13848	16683				2835
a86009579	18348	20633				2285
a86009580	22285	24615				2330
a86009586	37588	40093				2505
a86009587	45609	47674				2065
a86009588						
Part I	52013	53958				1945
Part II	54748	55258				510
a86009589	57726	60226				2500
a86009590	62682	65492				2810
a86009596	15458	16733	16043	16138	95	1180
a86009597	17722	25197	21152	21157	5	7470
a86009751	48200	50540				2340
a86009752	52207	55267				3060
a86009753	19162	22567				3400
a86009763	38230	41405	41155	41190	35	3140
a86009768	8589	12324	9614	9624	10	
			10084	10089	5	3720
a86009771	26869	29184				2315
	26849	26869				20

Table 7 (cont.): A summary of the processed SPEC5 MSDRS data

Flt. No.	Processed Time		Time Jump		Period	Total Time
	Start	End	Start	End	(s)	(s)
a86009778						
Part I	43737	45597				1860
Part II	45892	46442				550
a86009779	48730	51250	50635	50640	5	2520
a86009780	53318	55143				1825
a86009782	56724	61619	57954	57959	5	4890
a86009783	63393	67883	67283	67333	50	4440
a86009784						
Part I	4471	7216				2745
Part II	7546	8951	7631	7636	5	
			8741	8821	80	1320
a86009785						
Part I	10813	12573				1760
Part II	12913	14363				1450
a86009786	16005	18510	17970	17975	5	2505
a86009787						
Part I	20310	22300				1990
Part II	22570	23070				500
	23430	23585				155
a86009789						
Part I	25737	27692	26572	26577	5	1950
Part II	28047	28562				515
a86009790	30897	34467				3570
a86009791	37062	40747				3685
a86016601	55510	57345	56250	56255	5	1830
a86016604	63578	65723				2145
a86016605	1720	3820				2100
a86016608	19968	23818	23263	23298	35	3815
a86016612	36139	37919				1780
a86016617	53669	55424				1755
a86016622	11849	16589				4740
a86016624	21180	26245				5065
a86016638	905	2960				2055
a86016639	4858	6878				2020
a86016641	9267	14772	11472	11477	5	5500

Table 7 (cont.): A summary of the processed SPEC5 MSDRS data

Flt. No.	Processed Time		Time Jump		Period	Total Time
	Start	End	Start	End	(s)	(s)
a86016642	16091	21186				5095
a86016646	24306	27476				3170
a87006451	25182	26887				1705
a87006452	33562	38162				4600
a87006455	39216	41971	39781	39786	5	2750
a87006462	64151	66406				2255
a87006464	2120	4365	3005	3010	5	2245
a87006466	6865	9330				2465
a87006467	11025	13295				2270
a87006469	15248	18068				2820
a87006471	20399	22139	21369 21719	21374 21734	5 15	1720
a87006473	25152	27507				2355
a87006477	34059	36324				2265
a87006478	38212 40262	40247 40302				2035 40
a87006484	53532	54712				1180
a87006486	57213	58938				1725
a87006487	62087	64192	63182	63192	10	2095
a87008246	9827	12777				2950
a87008247	14765	16435				1670
a87008250	22020	23785				1765

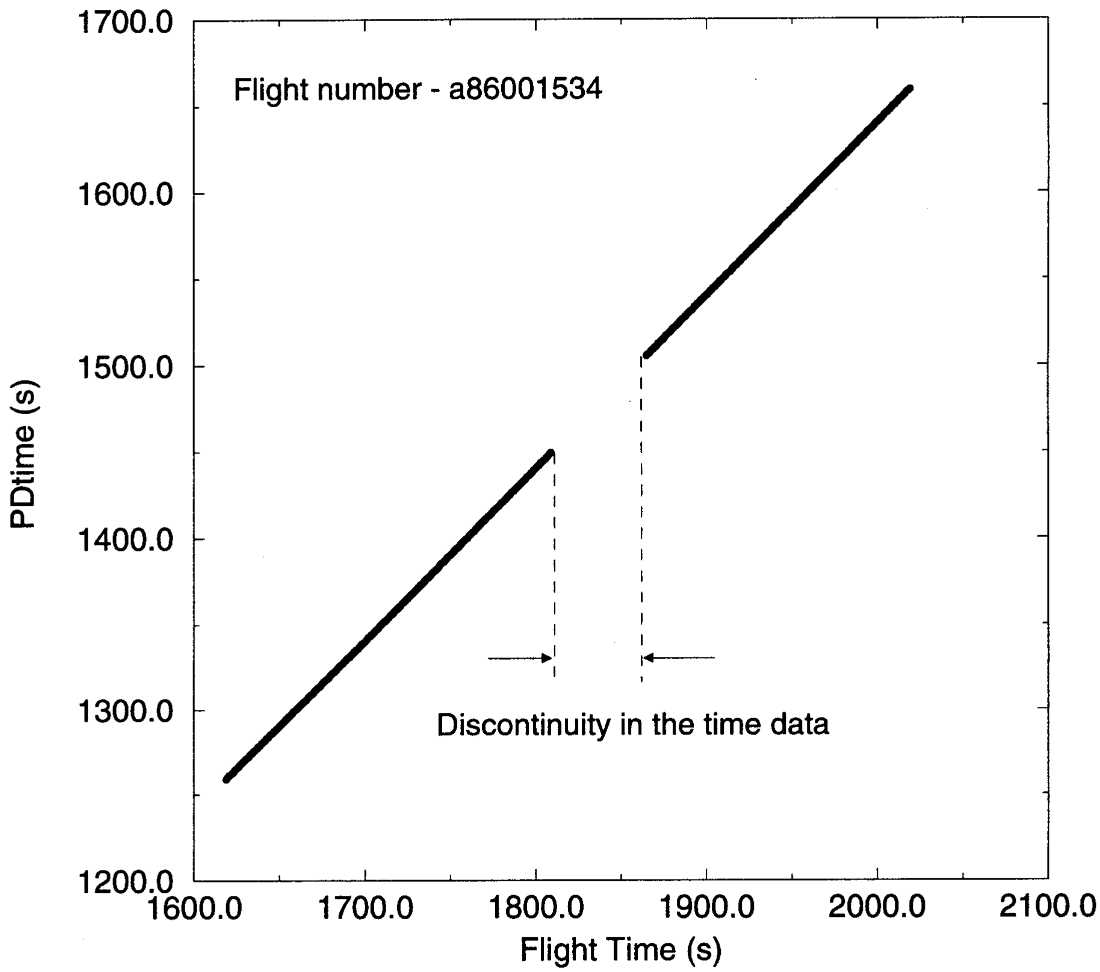

Figure 1: An example of a time jump in MSDRS data

Response Following Controller performance summary for flight 1252 ...... Flight Data Code 85.

Manoeuvring time analysed: 2484.0 seconds (100.0%) of 2484.0 second flight.

Reconstruction error summary in terms of data resolution;

Resolutions	Alpha	A_n	p	q	StabL	StabR	TefL	TefR	IbleL	IbleR	RudrL	RudrR
1	2291	1749	2405	2336	305	373	320	327	68	265	157	361
2	192	566	67	148	169	110	150	144	232	161	220	107
3	1	124	10	0	16	9	17	24	142	56	96	16
4	0	24	2	0	3	0	8	2	39	10	17	9
5	0	10	0	0	3	3	2	0	12	4	5	2
6	0	5	0	0	1	2	0	0	3	1	0	0
7	0	2	0	0	0	0	0	0	0	0	0	2
8	0	2	0	0	0	0	0	0	1	0	1	0
9	0	2	0	0	0	0	0	0	0	0	0	0
10	0	0	0	0	0	0	0	0	0	0	0	0
11	0	0	0	0	0	0	0	0	0	0	0	0
12	0	0	0	0	0	0	0	0	0	0	1	0
13	0	0	0	0	0	0	0	0	0	0	0	0
14	0	0	0	0	0	0	0	0	0	0	0	0
15	0	0	0	0	0	0	0	0	0	0	0	0
16	0	0	0	0	0	0	0	0	0	0	0	0
17	0	0	0	0	0	0	0	0	0	0	0	0
18	0	0	0	0	0	0	0	0	0	0	0	0
19	0	0	0	0	0	0	0	0	0	0	0	0
20	0	0	0	0	0	0	0	0	0	0	0	0

Reconstruction acceptability criteria;

Resolution	1.4000	.1250	4.0000	4.0000	.3500	.3500	.3500	.3500	.3500	.3500	.3500	.3500
50% Threshold	2.8000	.2500	4.0000	4.0000	1.0500	1.0500	1.0500	1.0500	1.0500	1.0500	2.1000	2.1000
90% Threshold	5.6000	.5000	8.0000	8.0000	2.1000	2.1000	2.1000	2.1000	2.1000	2.1000	4.2000	4.2000

Reconstruction Performance;

50% Acceptability	.9996	.9320	.9682	.9404	.9859	.9899	.9799	.9960	.8893	.9698	.9960	.9960
50% Confidence	.9989	.8286	.9333	.8875	.9544	.9583	.9411	.9885	.7983	.9196	.9800	.9795
90% Acceptability	1.0000	.9915	.9952	1.0000	1.0000	1.0000	1.0000	1.0000	.9980	1.0000	1.0000	1.0000
90% Confidence	1.0000	.9632	.9853	1.0000	1.0000	1.0000	1.0000	1.0000	.9933	1.0000	1.0000	1.0000

Measurand Extrema;

Msdrs_Max	8.440	6.250	72.000	16.000	2.110	1.760	12.300	12.300	11.250	11.950	7.380	6.680
Model_Max	9.590	6.125	80.786	14.658	2.526	1.999	12.312	12.366	11.755	11.755	7.894	7.894
Msdrs_Min	.000	.250	-140.000	-4.000	-7.030	-4.570	1.050	.700	-.350	-.350	-1.760	-1.760
Model_Min	.595	.290	-137.657	-2.398	-7.263	-4.021	1.475	.482	-.092	-.037	-3.635	-3.635

Figure 2: An example of the output from RFCF85

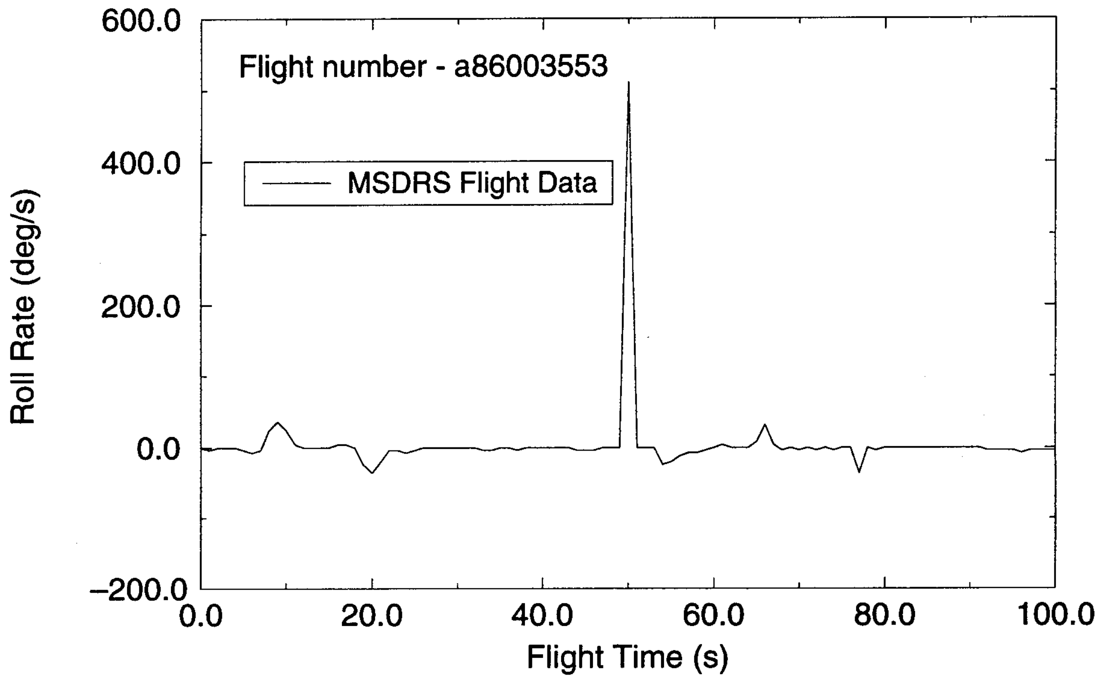

Figure 3: An example of a spike in the MSDRS roll rate data

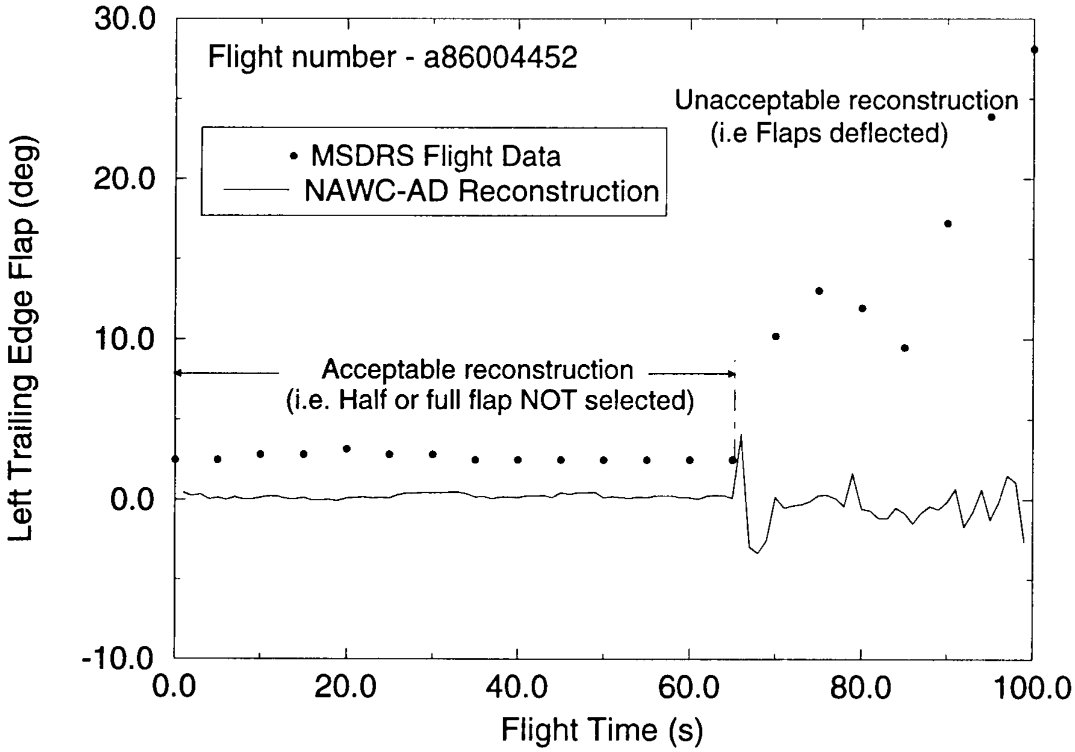

Figure 4: An example of pilot commanded flap deflection

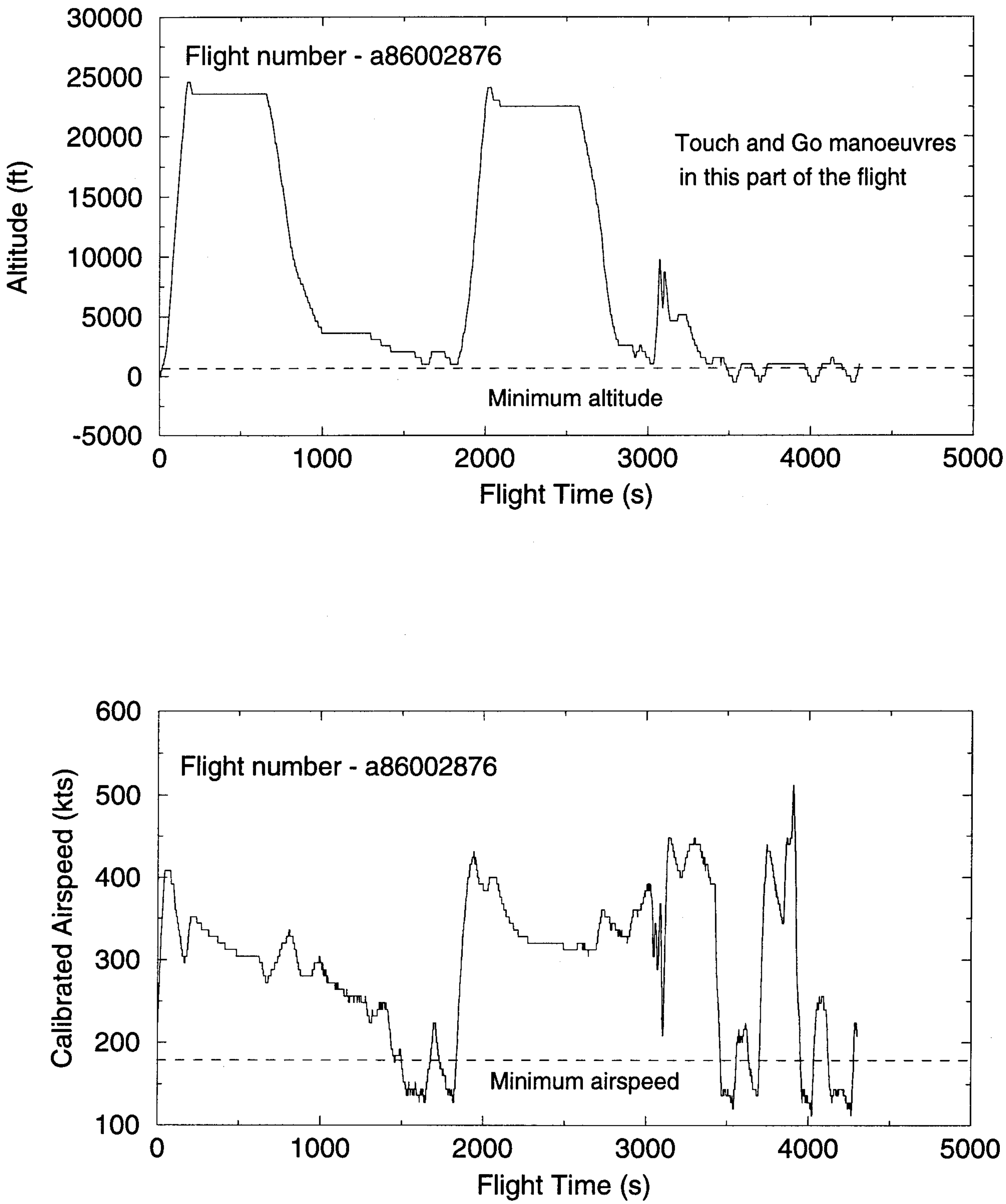

Figure 5: An example of a Touch and Go during a flight

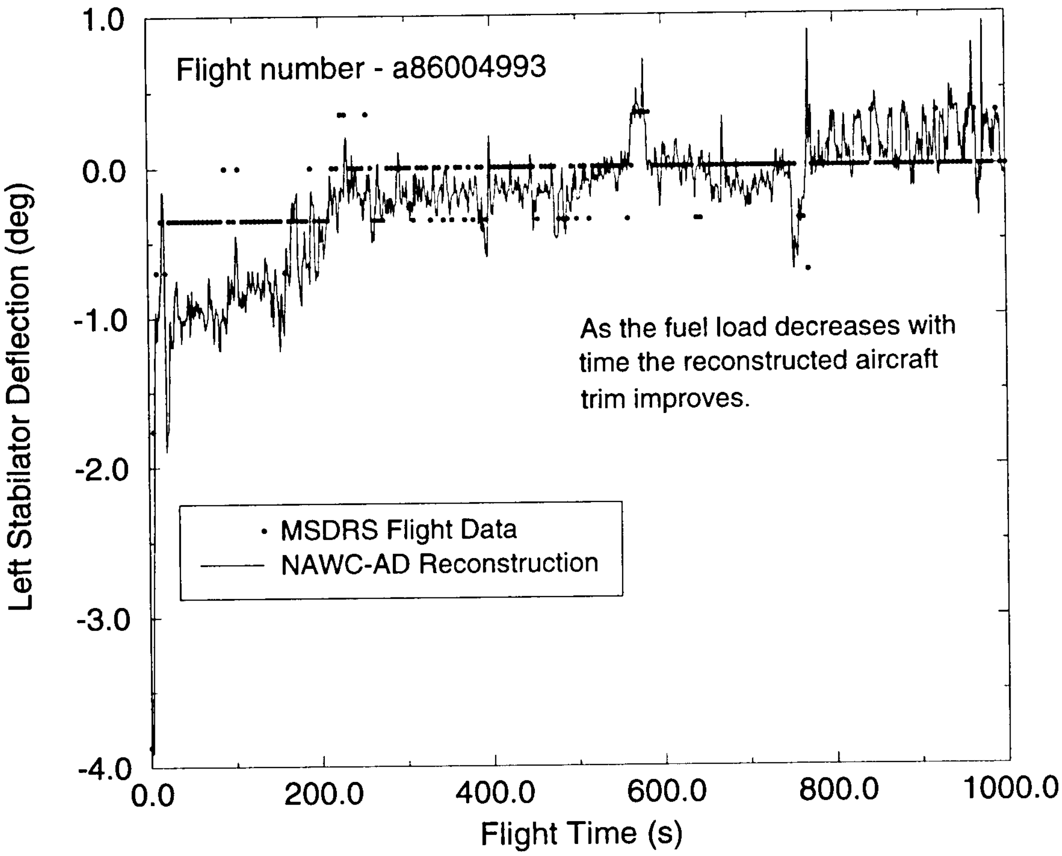

Figure 6: The effects of a total fuel load in excess of 10860 lb (4936 kg) on aircraft trim

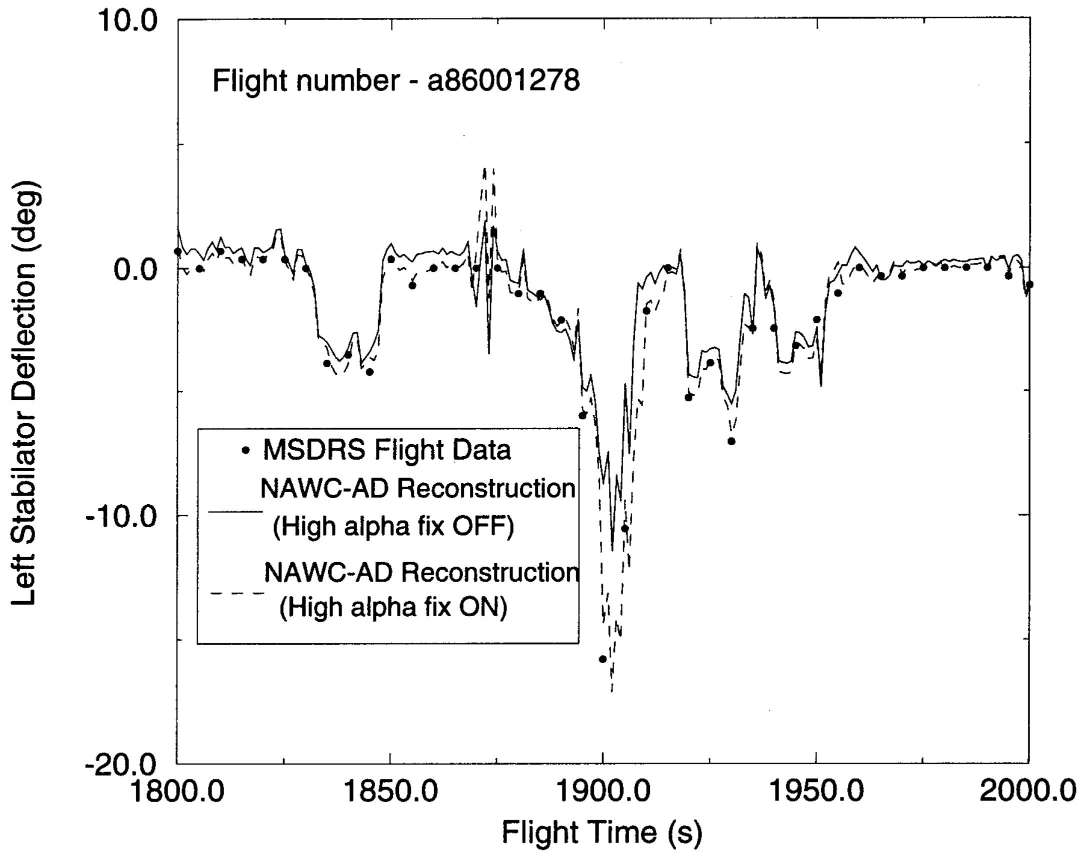

Figure 7: An example of a high angle of attack flight

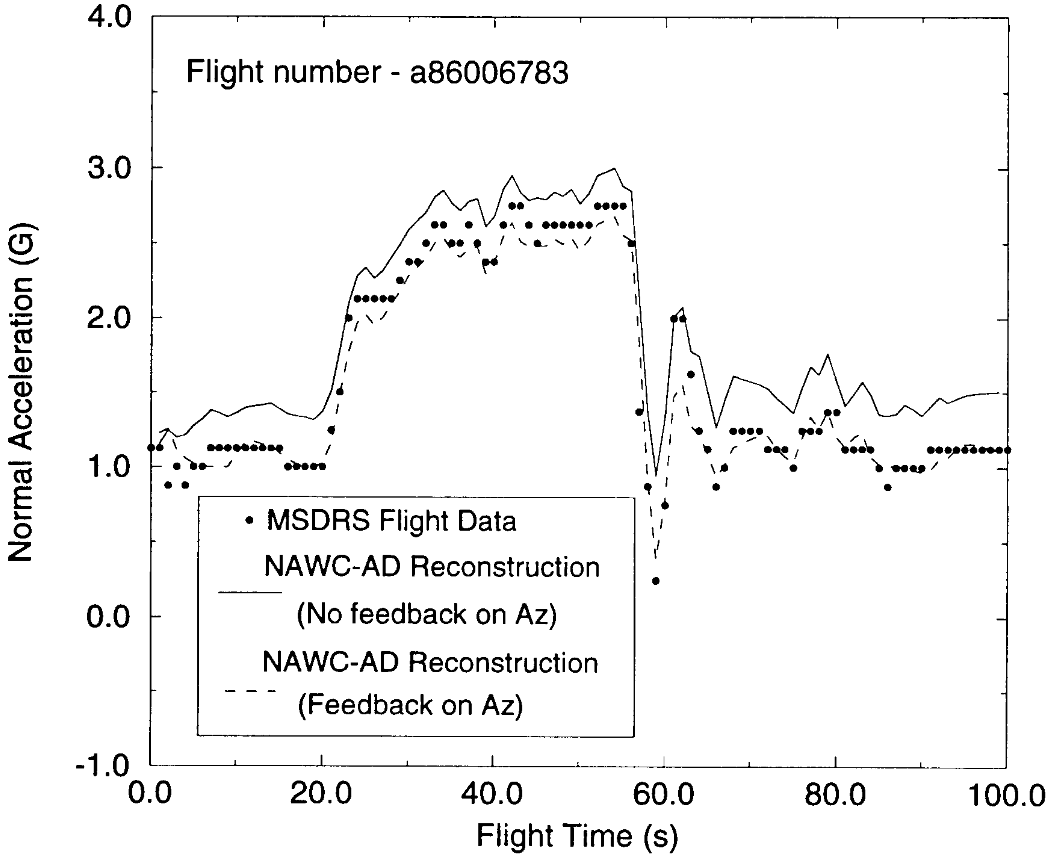

Figure 8: An example of a reconstruction using feedback on normal acceleration

Appendix A

An F/A-18 MSDRS Data Enhancement Log

FA18 MSDRS Data Enhancement Log

Case no : a86001252 Flight Type : 40 Code Type : 85
Flight Date : 25/ 3 / 86 Flight Duration : 1·0 hr.

flt_times.**** has continuous time history between FT 16504 and 19123 .
Check graph of fatigue PD time vs recording FT : ✓ .
From velocity plot and file, restrict FT to 16517 < FT < 19009.
From altitude plot and file, use data between FT 16518 and 19008 .
Total processed flight time = 2490 sec = 0·69 hr.
Filter re-ran with modified flight times ? ✓ .

Trim conditions :

α = 5·63 ° θ = 8·44 ° ϕ = 2·81 ° V = 200 kts
Alt= 0 ft $\gamma = \theta - \alpha$ = 2·81 °

FPR HWR 0·1 . FPR Bias Limit 5 °/s

From FPR program, check : Calculated vs. measured ϕ ✓ .
Calculated vs. measured θ ✓ .
Calculated vs. measured ψ ✓ .

Transferred 'fb' files to Zodiac directory named : case_1.
Deleted 'fb' files from Hrun ? ✓ .
Moved output from */fpr* to */f18_loads ?* ✓ .
Commenced F18NATC run on : 9 / 10 / 92.
Checked for successful completion on : 12 / 10 / 92.
Transferred loads files from Zodaic to Hrun ? ✓ .
Combined loads files into file named : load. 1252.

Check of : p (column 07) with MSDRS data : ✓ .
q (column 22) with MSDRS data : ✓ .
Az (column 05) with MSDRS data : ✓ .
α (column 06) with MSDRS data : ✓ .
δ_{Lstab} (column 09) with MSDRS data : ✓ .
δ_{Lrudd} (column 11) with MSDRS data : ✓ .

Summary sheet produced ? ✓ .

Binary data files created ? ✓.
Loads files and binary files transferred to Lady Susan ? ✓.
Files deleted from Hrun ? ✓.
Files transferred from Lady Susan to mag tape on : 12 / 10 / 92.
Processed flights record updated ? ✓.

Problems / Notes :

1. Flight contains time jumps. The continuous F-Time ranges are ;

15616 → 15680

16504 → 19123 – Consider this range only for processing.

The details shown on this log sheet are typical of the information recorded during the enhancement of the SPEC5 flights.

Appendix B

A DEBUG configuration file for the NAWC-AD F/A-18 flight dynamic model

```
SET BREAK DEB

SET SCOPE SMART

DEP BATCH_MODE=1                    ! Variable used to toggle batch mode
DEP FLT_NO='2887'                   ! Input file extention

               *   *   *  BASIC FLIGHT CONDITIONS  *   *   *

SET MODULE SETUP
DEP IMACH=-2                        ! Initial velocity flag; -2 --> VCAL
DEP VEQIC=240.0                     ! Initial VCAL (knots)
DEP HIC=512.0                       ! Initial altitude (feet)
DEP DT2=0.0125                      ! Simulation frequency (not changed)
DEP TEND=2620.0                     ! Length of simulation in seconds

SET MODU BSETUP
DEP GAMVIC=2.81                     ! Initial flight path angle (deg.)
DEP THETIC=7.03                     ! Initial pitch angle (deg.)
DEP ALFIC=4.22                      ! Initial angle of attack (deg.)
DEP PHIIC=1.41                      ! Initial bank angle (deg.)

SET MODULE WRITE_TSDATA
DEP MAX_IO=80                       ! Output frequency; dump every #th / 80
DEP T_SHIFT=0.0                     ! Time offset
CANCEL WRITE_TSDATA

                *   *   *  FEEDBACK CONTROL FACTORS  *   *   *

SET MODULE CHECKFB
DEP CONV_PQR=0                  !  Convert p,q,r input : 0 = rad. & 1 = deg.
DEP LEAD_TIME=0.0                   !          DO NOT CHANGE
DEP FBUsingG=0                      ! Pitch FB on Q -> 0, on G -> 1
DEP FB_DoTGS=0                      ! Touch and Goes; ON -> 1, OFF -> 0
DEP FBK1P=-100.0                    !           "        "
DEP FBK2P=15.0                      !           "        "
DEP FBK3P=-2.5                      !           "        "
DEP FBK1Q=0.0                       !     Q -> 0.0  or  G -> -0.4
DEP FBK2Q=0.0                       !           "        "
DEP FBK3Q=0.0                       !     Q -> 0.0  or  G -> -0.08
DEP FBK1R=0.0                       !           "        "
DEP FBK2R=0.0                       !           "        "
DEP FBK3R=0.0                       !           "        "
DEP FBKTAU=0.9                      !           "        "
DEP FBKALT=1.0                      !           "        "
DEP FBKDR=1.0                 !    0.0 <-> 1.0 (fb dr to full input dr)
DEP FBKR=0.0                  !    0.0 <-> 1.0 (none <-> full r correct)
DEP FB_CorrectControls=1     !  Use drift correction on control surface out
DEP FBKControls=0.8          !  0.0 <-> 1.0 ( NO stab correction <-> FULL )
DEP FBDEBUG=0                       !           "        "
DEP FBLEVER=0                       !           "        "
DEP SCR_COUNT=400                   !           "        "
DEP DUMP_COUNT=40                   !           "        "
DEP FBTHRUST=0                      ! FEX NOT MODIFIED IN SMART.FOR (y/n)
```

```
* * * CONFIGURATION FLAGS & VARIABLES * * *

SET MODU WAITIN          ! NOMINAL VALUES FOR INERTIAS
DEP ICLTNK=0             ! Centre link tank where -   0 = OFF, 1 = ON
DEP ITFCAN=0             ! Canopy where -  0 = F/A-18A, 1 = F/A-18B
DEP IBURN=1              ! Fuel burn model where -  0 = OFF, 1 = ON
DEP IOVRCG=0

        If IOVRCG = 1 then the following must be set

DEP WAITIC=32545.8       ! Initial total weight of a/c
DEP XIXXIC=23196.0       ! Inertia Ixx (Slugs ft^2)
DEP XIYYIC=126092.0      ! Inertia Iyy (Slugs ft^2)
DEP XIZZIC=145340.0      ! Inertia Izz (Slugs ft^2)
DEP XIXZIC= -3115.0      ! Inertia Ixz (Slugs ft^2)
DEP CG=0.2210            ! CG position (% MAC)

       Else if IOVRCG = 0 then the following must be set

DEP WFINT=6000.0         ! Initial total weight of aircraft
DEP FUEL3X=0.0           ! Fuel in ext. wing tank - Station 3 (lbs)
DEP FUEL5X=0.0           ! Fuel in centre line tank (LBS)
DEP FUEL7X=0.0           ! Fuel in ext. wing tank - Station 7 (lbs)

               * * * STORES CONFIGURATION * * *

  LAUNCHER WEIGHTS/NUMBERS WEIGHTS (LBS) NUMBER : O - None  # - Number

DEP WLNCHR(1)=0.0
DEP ILNCHR(1)=0
DEP WLNCHR(2)=59.0
DEP ILNCHR(2)=0
DEP WLNCHR(3)=115.0
DEP ILNCHR(3)=0
DEP WLNCHR(4)=0.0
DEP ILNCHR(4)=0
DEP WLNCHR(5)=0.0
DEP ILNCHR(5)=0
DEP WLNCHR(6)=0.0
DEP ILNCHR(6)=0
DEP WLNCHR(7)=115.0
DEP ILNCHR(7)=0
DEP WLNCHR(8)=59.0
DEP ILNCHR(8)=0
DEP WLNCHR(9)=0.0
DEP ILNCHR(9)=0

    MK-83 WEIGHTS/NUMBER WEIGHTS (LBS) NUMBER : O - None  # - Number

DEP WMK83(1)=0.0
DEP NMK83(1)=0
DEP WMK83(2)=985.0
DEP NMK83(2)=0
DEP WMK83(3)=985.0
DEP NMK83(3)=0
DEP WMK83(4)=0.0
DEP NMK83(4)=0
DEP WMK83(5)=985.0
DEP NMK83(5)=0
DEP WMK83(6)=0.0
DEP NMK83(6)=0
```

```
DEP WMK83(7)=985.0
DEP NMK83(7)=0
DEP WMK83(8)=985.0
DEP NMK83(8)=0
DEP WMK83(9)=0.0
DEP NMK83(9)=0

     PYLONS WEIGHTS/NUMBER WEIGHTS (LBS) NUMBER : 0 - None  # - Number

DEP WPYLON(1)=0.0
DEP IPYLON(1)=0
DEP WPYLON(2)=273.0
DEP IPYLON(2)=0
DEP WPYLON(3)=273.0
DEP IPYLON(3)=0
DEP WPYLON(4)=0.0
DEP IPYLON(4)=0
DEP WPYLON(5)=130.0
DEP IPYLON(5)=0
DEP WPYLON(6)=0.0
DEP IPYLON(6)=0
DEP WPYLON(7)=273.0
DEP IPYLON(7)=0
DEP WPYLON(8)=273.0
DEP IPYLON(8)=0
DEP WPYLON(9)=0.0
DEP IPYLON(9)=0

     RACK WEIGHTS/NUMBER WEIGHTS (LBS) NUMBER : 0 - None  # - Number

DEP WTRACK(1)=0.0
DEP IRACK(1)=0
DEP WTRACK(2)=175.0
DEP IRACK(2)=0
DEP WTRACK(3)=175.0
DEP IRACK(3)=0
DEP WTRACK(4)=0.0
DEP IRACK(4)=0
DEP WTRACK(5)=0.0
DEP IRACK(5)=0
DEP WTRACK(6)=0.0
DEP IRACK(6)=0
DEP WTRACK(7)=175.0
DEP IRACK(7)=0
DEP WTRACK(8)=175.0
DEP IRACK(8)=0
DEP WTRACK(9)=0.0
DEP IRACK(9)=0

    SPARROW WEIGHTS/NUMBER WEIGHTS (LBS) NUMBER : 0 - None  # - Number

DEP WSPROW(1)=0.0
DEP ISPROW(1)=0
DEP WSPROW(2)=510.0
DEP ISPROW(2)=0
DEP WSPROW(3)=0.0
DEP ISPROW(3)=0
DEP WSPROW(4)=510.0
DEP ISPROW(4)=1
DEP WSPROW(5)=0.0
DEP ISPROW(5)=0
DEP WSPROW(6)=510.0
DEP ISPROW(6)=1
DEP WSPROW(7)=0.0
```

```
DEP ISPROW(7)=0.0
DEP WSPROW(8)=510.0
DEP ISPROW(8)=0
DEP WSPROW(9)=0.0
DEP ISPROW(9)=0.0

EXTERNAL TANKS WEIGHTS/NUMBER WEIGHTS (LBS) NUMBER : O - None  # -
Number

DEP WXTANK(1)=0.0
DEP IXTANK(1)=0
DEP WXTANK(2)=0.0
DEP IXTANK(2)=0
DEP WXTANK(3)=300.0
DEP IXTANK(3)=0
DEP WXTANK(4)=0.0
DEP IXTANK(4)=0
DEP WXTANK(5)=300.0
DEP IXTANK(5)=0
DEP WXTANK(6)=0.0
DEP IXTANK(6)=0
DEP WXTANK(7)=300.0
DEP IXTANK(7)=0
DEP WXTANK(8)=0.0
DEP IXTANK(8)=0
DEP WXTANK(9)=0.0
DEP IXTANK(9)=0

  SIDEWINDERS WEIGHTS/NUMBER WEIGHTS (LBS) NUMBER : O - None # - Number

DEP WWINDR(1)=195.0
DEP IWINDR(1)=1
DEP WWINDR(2)=195.0
DEP IWINDR(2)=0
DEP WWINDR(3)=0.0
DEP IWINDR(3)=0
DEP WWINDR(4)=0.0
DEP IWINDR(4)=0
DEP WWINDR(5)=0.0
DEP IWINDR(5)=0
DEP WWINDR(6)=0.0
DEP IWINDR(6)=0
DEP WWINDR(7)=0.0
DEP IWINDR(7)=0
DEP WWINDR(8)=195.0
DEP IWINDR(8)=0
DEP WWINDR(9)=195.0
DEP IWINDR(9)=1

SET MODU PFC17           ! CAN RUN 1st OR 2nd ORDER ACTUATORS
DEP IACTR=2        ! IACTR=1st order, IACTR=2nd order

SET MODU AIRDAOA
DEP IAFU=1               ! Fly in auto flaps up mode

GO
QUIT
```

Appendix C

A batch run file for the NAWC-AD F/A-18 flight dynamic model

TRIM	-	Trim the model to the initial configuration specified in the trim file
RUN	-	Commence the simulation from the trimmed condition
3 Y N Y Y	-	Typical responses to the simulation options
END	-	Terminates the simulation
QUIT	-	Exit DEBUG

Enhancement of F/A-18 Operational Flight Measurements
Data Report for Phase 1

B.A. Woodyatt, J. Bennett and S.D. Hill

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AR-008-910	DSTO-TR-0049	AUGUST 1994	AIR 88/053

4. TITLE	5. SECURITY CLASSIFICATION (PLACE APPROPRIATE CLASSIFICATION IN BOX(S) IE. SECRET (S), CONF. (C) RESTRICTED (R), LIMITED (L), UNCLASSIFIED (U)).	6. NO. PAGES / 7. NO. REFS.
ENHANCEMENT OF F/A-18 OPERATIONAL FLIGHT MEASUREMENTS DATA REPORT FOR PHASE 1	DOCUMENT: U; TITLE: U; ABSTRACT: U	6. NO. PAGES: 73 7. NO. REFS.: 3

8. AUTHOR(S)	9. DOWNGRADING/DELIMITING INSTRUCTIONS
B.A. Woodyatt J. Bennett S.D. Hill	Not applicable.

10. CORPORATE AUTHOR AND ADDRESS	11. OFFICE/POSITION RESPONSIBLE FOR:
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14. DESCRIPTORS	15. DISCAT SUBJECT CATEGORIES
F/A-18 aircraft F/A-18 Maintenance Status Display and Recording System Aircraft maintenance; Data acquisition In flight monitoring; International Follow-on Structural Test Programme	010303

16. *ABSTRACT*

This report describes the procedures used in the processing of approximately 300 hours of flight maintenance data from the F/A-18's Maintenance Status Display and Recording System (MSDRS). A Flight Path Reconstruction (FPR) program and a modified F/A-18 mathematical model from the US Naval Air Warfare Center Aircraft Division (NAWC-AD) were used to enhance these flight data in resolution and frequency. DSTO's Airframes and Engines Division (AED) will use these enhanced flight data to obtain a representative flight load spectrum. The load spectrum will be used in a full scale fatigue test of the empennage and aft fuselage of an F/A-18, the Australian contribution to the International Follow-On Structural Test Programme (IFOSTP). IFOSTP is a joint collaboration between the Canadian Forces (CF) and the Royal Australian Air Force (RAAF) to appraise structural modifications to the F/A-18 designed to achieve a service life of 6000 hours.

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16. ABSTRACT (CONT).

17. IMPRINT

AERONAUTICAL AND MARITIME RESEARCH LABORATORY, MELBOURNE

18. DOCUMENT SERIES AND NUMBER	19. WA NUMBER	20. TYPE OF REPORT AND PERIOD COVERED
DSTO Technical Report 0049		

21. COMPUTER PROGRAMS USED

22. ESTABLISHMENT FILE REF.(S)

M1/8/805

23. ADDITIONAL INFORMATION (AS REQUIRED)